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NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

MICROCOMPUTER BASED
INTERACTIVE DISPLAY SYSTEM

by

Francisco J. Mariategui C.

and

Ivan Nelson Hall Jr.

June 1979

Thesis Advisor: G. Rahe

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This study was undertaken to design and implement a microcomputer based interactive display system suitable for use as a shipboard tactical-situation display. The stand-alone system included two plasma display scopes, one microcomputer, one CRT and one line printer. The scope of the effort included the interface of the display system via a RS-232 data/link to a PDP-11/50 minicomputer in order to emulate the

(20. ABSTRACT Continued)

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Microcomputer Based Interactive Display System

by

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MASTER OF SCIENCE IN COMPUTER SCIENCE

from the

NAVAL POSTGRADUATE SCHOOL

June 1979

ABSTRACT

This study was undertaken to design and implement a microcomputer based interactive display system suitable for use as a shipboard tactical-situation display. The stand-alone system included two plasma display scopes, one micro-computer, one CRT and one line printer. The scope of the effort included the interface of the display system via a RS-232 data/link to a PDP-11/50 minicomputer in order to emulate the shipboard tactical environment. Of major interest was the integration of the hardware components and the software developed in this study into a coherent alphanu-merical and graphical display system

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I. INTRODUCTION

The purpose of this study is to design and implement a microcomputer based interactive display system suitable for use as a shipboard tactical display. The basic display system consists of a microcomputer, 2 plasma display scopes, 1 plasma touch panel, 1 CRT and 1 line printer (Fig. 1). The shipboard tactical environment is simulated by interfacing the display system to a PDP-11/50 minicomputer which emulates an information source (Fig. 2).

The display system is designed to support data reception, remote processing (manipulation and handling of data to build the local data bases), information display of graphical and alphanumerical data and a Man-Machine Interface. The environment emulated at the PDP Minicomputer provides a data subset of the Naval Tactical Data System (NTDS), [Ref. 19]. The subset of information is provided via the PDP interface to the display system. The information consists of the Surface contact profile subset of the NTDS.

Chapter II contains the introduction to the problem and the development strategy. Chapter III contains a discussion of the different display modes implemented in the system. The hardware components are discussed in Chapter IV. A detailed description of the interface between both computers is presented in Chapter V. An overview of all the software developed is given in Chapter VI and in Chapter VII the

development process of this study is summarized. The final conclusions and recommendations of this study are presented in Chapter VIII.

DISPLAY SYSTEM BLOCK DIAGRAM

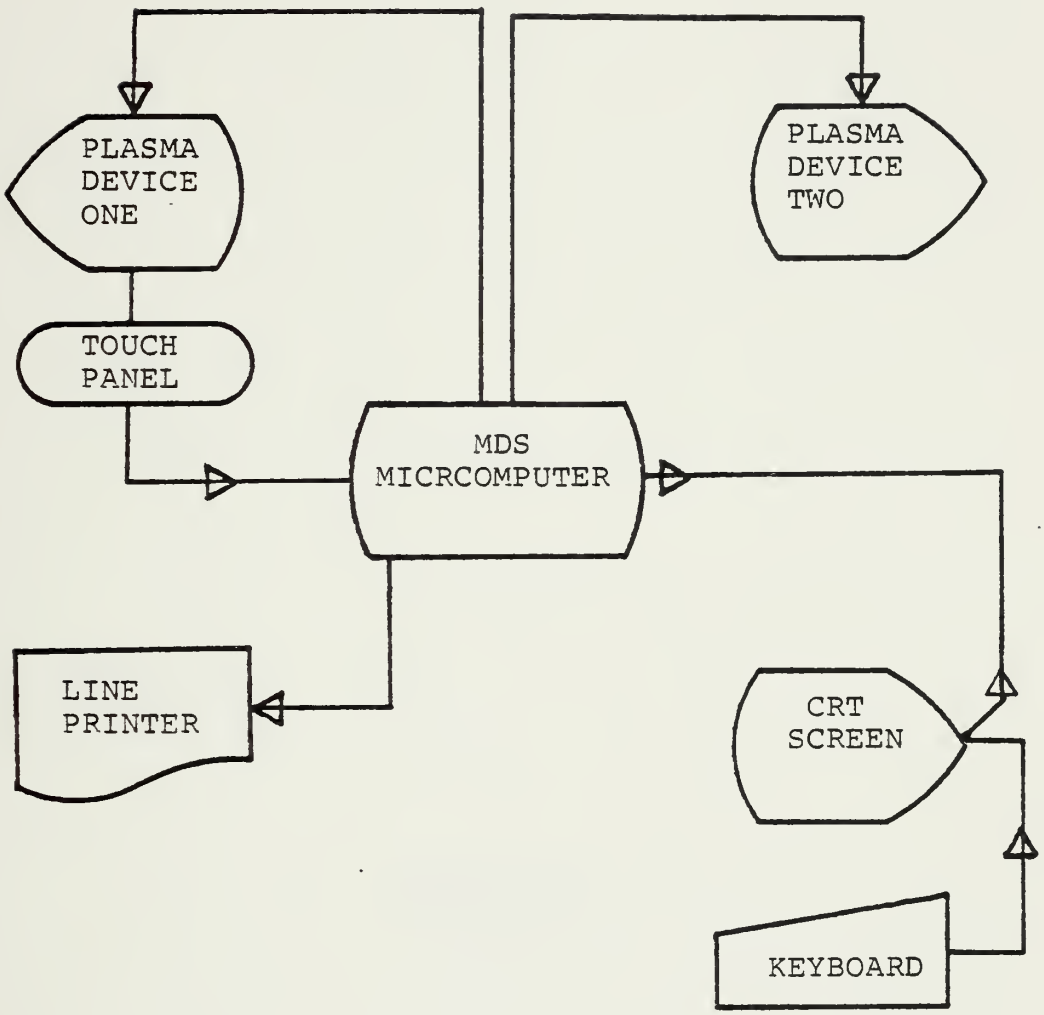


FIGURE 1

SYSTEM BLOCK DIAGRAM

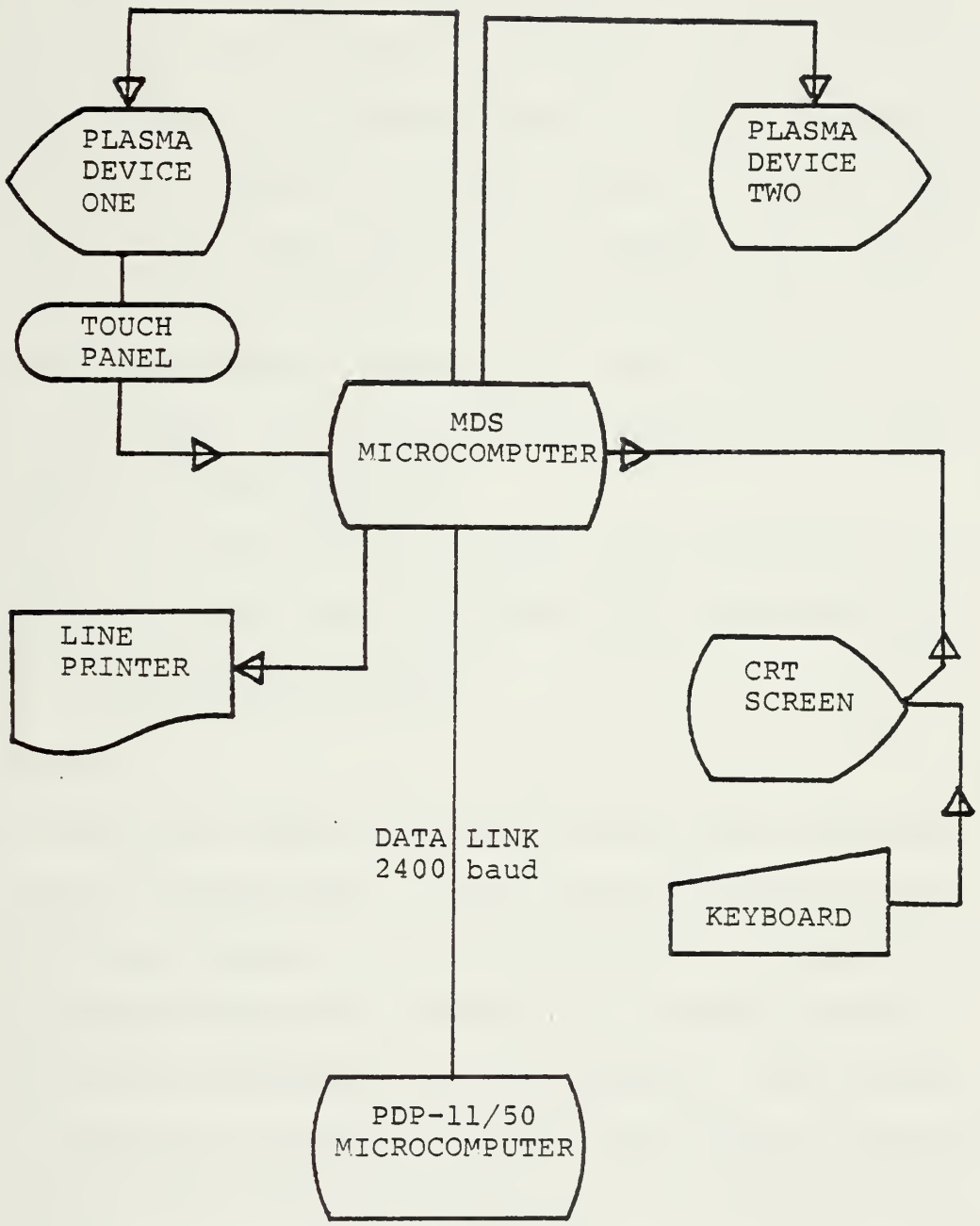


FIGURE 2

II. INTRODUCTION TO THE PROBLEM

A. PREFACE

In order to accomplish the Display of a shipboard tactical situation, microcomputer and plasma-display technologies were chosen as a technical base to design a "microcomputer based interactive display system." The shipboard tactical situation was provided by a hardware and software interface between the display system microcomputer and a PDP-11/50 (Minicomputer technology). The PDP was responsible for emulating the appropriate environment for the display system via the interface.

This study deals with the design and implementation of the "display system," the "interface," and the establishment of a Tactical environment.

B. SCENARIO

In order for a ship to maintain operational readiness as a unit of a task force, it must be aware of the current operational environment. The operational environment is defined as the subsurface, surface and airborne contact profiles in the geographic area of interest. The contact profile consists of friendly, hostile, and unknown contacts with associative contact characteristics. Contact characteristics are such data as latitutde, longitude, course, speed, range, bearing, etc.

In typical task force situations, the command unit has the responsibility for the collection, analysis and dissemination of all information defining the operational environment. If a unit has NTDS capability, the information describing the operational environment is provided by the command unit via a radio link. The unit relies on the mainframe computer of the command unit for all information, analysis and two way communications. If a unit is a non-NTDS ship, the unit still relies on the mainframe computer of the command unit for information, but only through a one way teletype link. No analysis capability is provided. Once the non-NTDS unit receives the information, the data is manually plotted and analyzed. The procedure is not only time consuming but also requires from one to four watch personnel depending on the unit's condition of readiness.

This study demonstrates the feasability of implementing an interactive display system using microcomputer and plasma display technologies for non-NTDS type ships. The display system implemented provides the capability to present a surface contact profile which constitutes the operational scenario on which the display system is based. For the purpose of this study, a PDP-11/50 minicomputer was utilized to emulate the information source or main frame computer of a command ship in a task force.

The operational scenario established for the study consisted of the PDP-11/50 computer generating a surface contact profile data base for a geographic region. The data

base is updated and transmitted to the display system in two minute intervals. Upon the reception of the data, the display system has the responsibility for building the local data base.

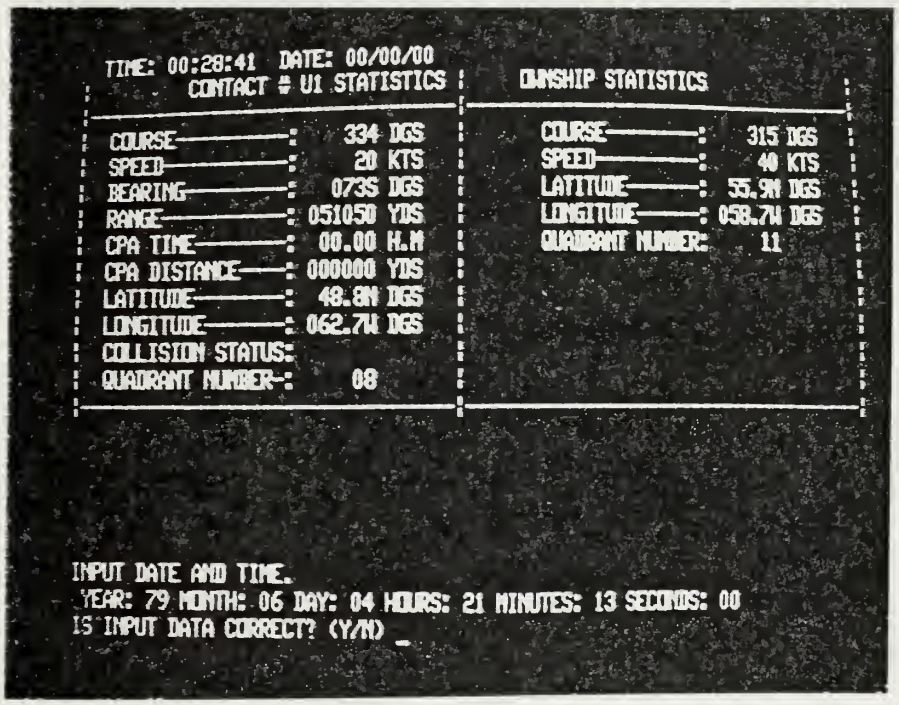
The data base constitutes the information that is presented at the display system in alphanumeric and graphical modes. The display system has the capability to allow operator interaction to query the system for presentation of specific contact alphanumeric or graphical characteristics relative to "ownship." Once the operator obtains the characteristics of a contact of interest, he can obtain a hard-copy via the display system teletype for dissemination.

The initialization of the display system begins with the setting of the system real-time clock and date. The operator enters: year, month, day, hours, minutes and seconds. The CRT screen presents the operator input as shown in figure 3.

Upon completion of the entry of the time and date of a tactical situation, the display system enters a ready state for the reception of data or operator interaction.

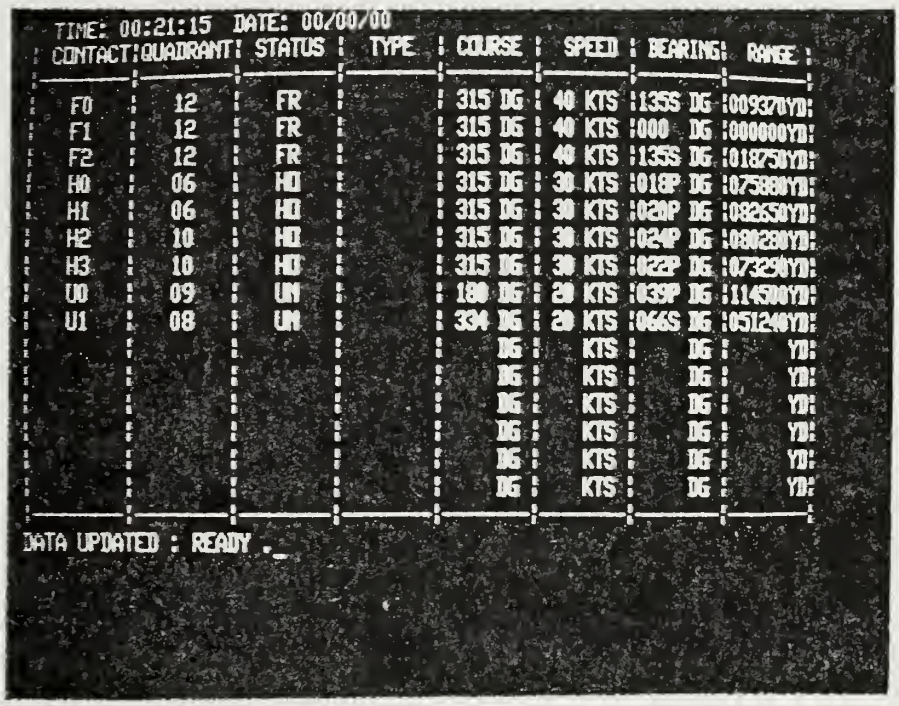
After the reception of a data set, the display system presents at the CRT screen the general contact characteristics as shown in figure 4. The general contact characteristics are also presented in a graphical format at the plasma scopes as shown in figure 5.

At any time the operator can request a list of command options to be presented at the CRT screen as shown in figure 6. The command options are the medium the operator



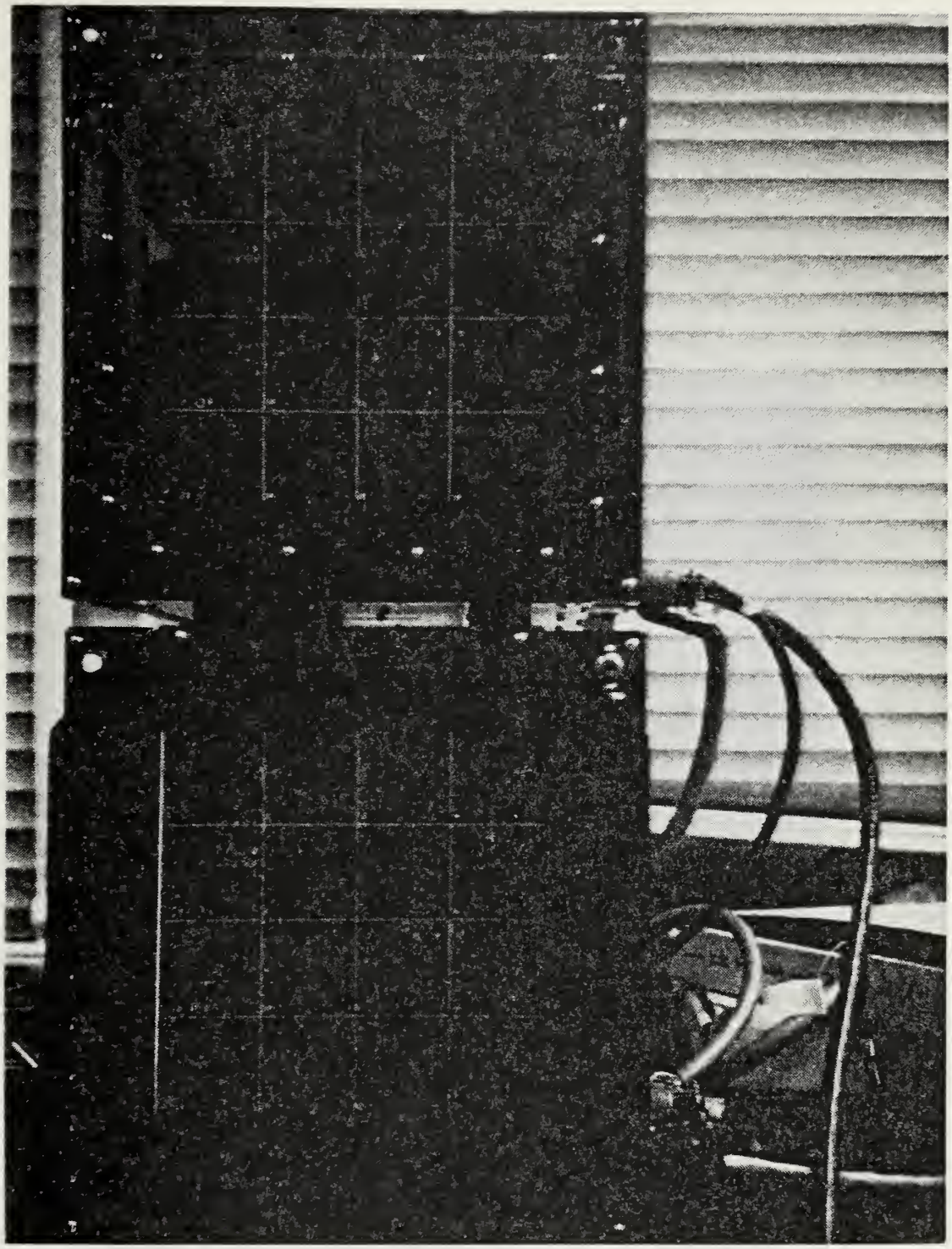
INITIALIZATION OF DATE AND TIME

FIGURE 3



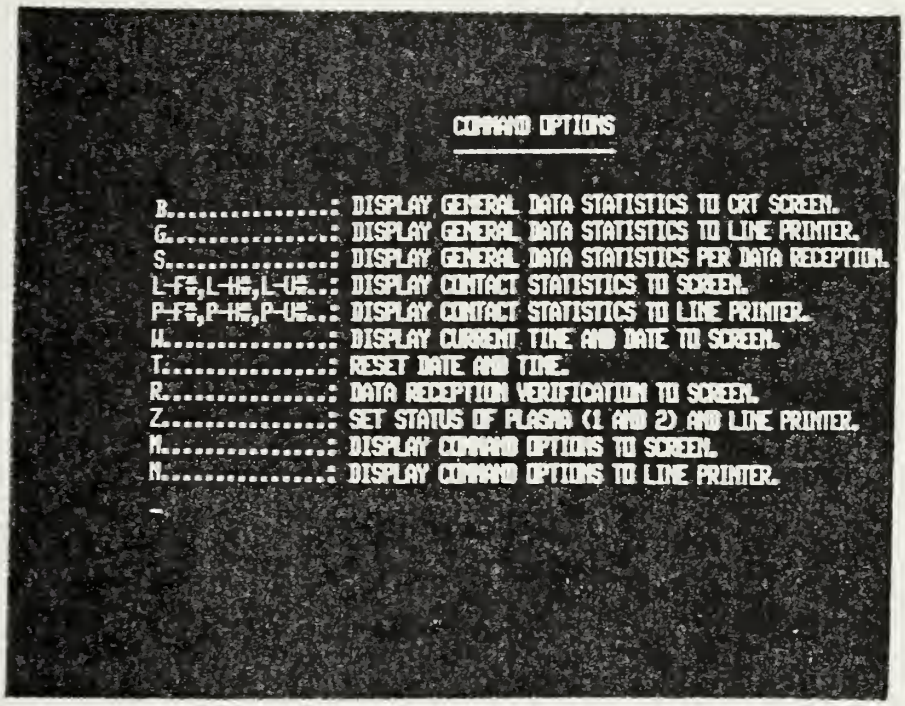
GENERAL CONTACT CHARACTERISTICS

FIGURE 4



GRAPHICAL PRESENTATION AT PLASMA SCOPES

FIGURE 5



COMMAND OPTIONS AT CRT SCREEN

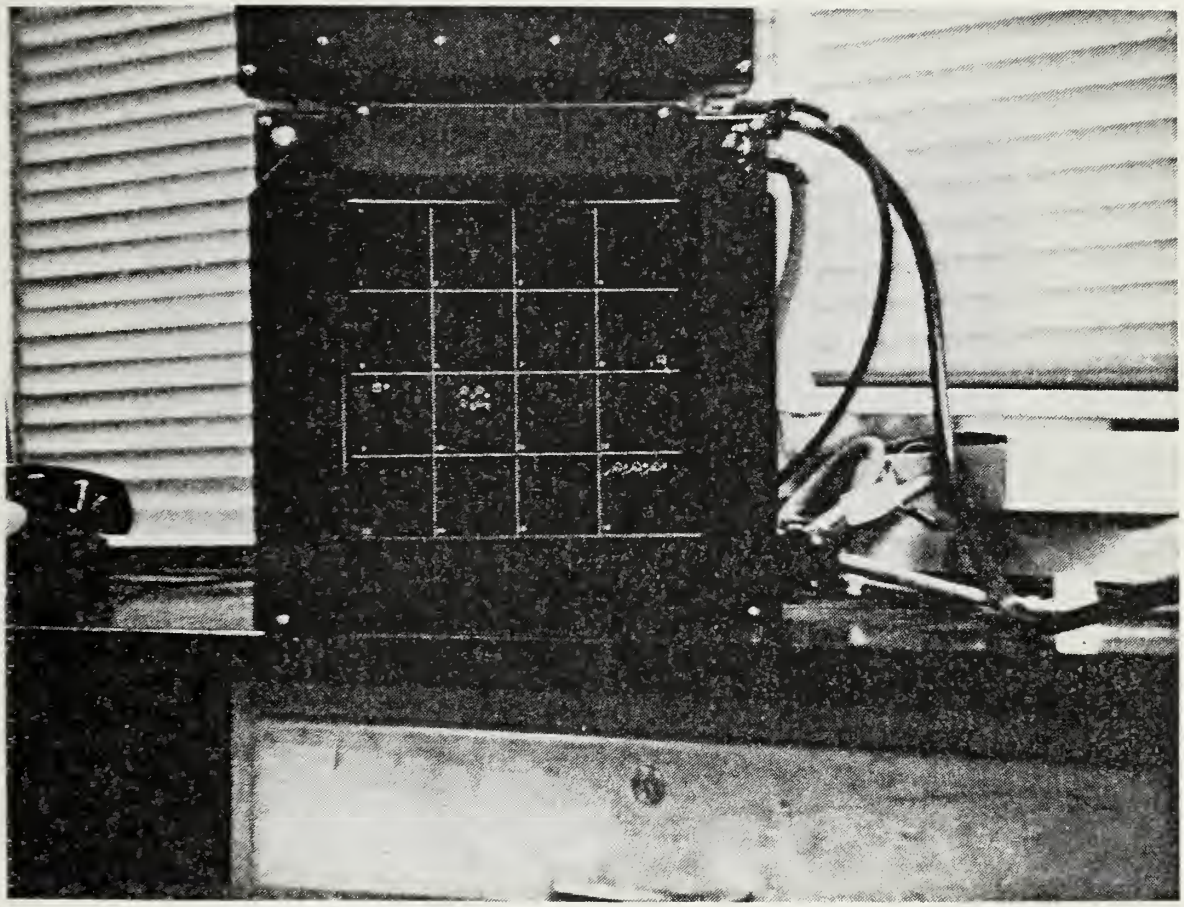
FIGURE 6

uses to interact with the display system. The operator may request general or specific contact data, set display modes, and initialize or shutdown display system hardware components.

The graphical data display at the plasma scopes is presented in a primary and secondary type of display. The primary plasma scope presents the surface contact profile of interest showing the symbolic representation of contacts with vector tails representing contact speed and course. The primary plasma scope is shown in figure 7 and the primary plasma display is shown in figure 8. The secondary plasma scope presents the surface contact profile of interest showing just the symbolic representation of the contacts. The secondary plasma scope is shown in figure 9 and the secondary plasma display is shown in figure 10.

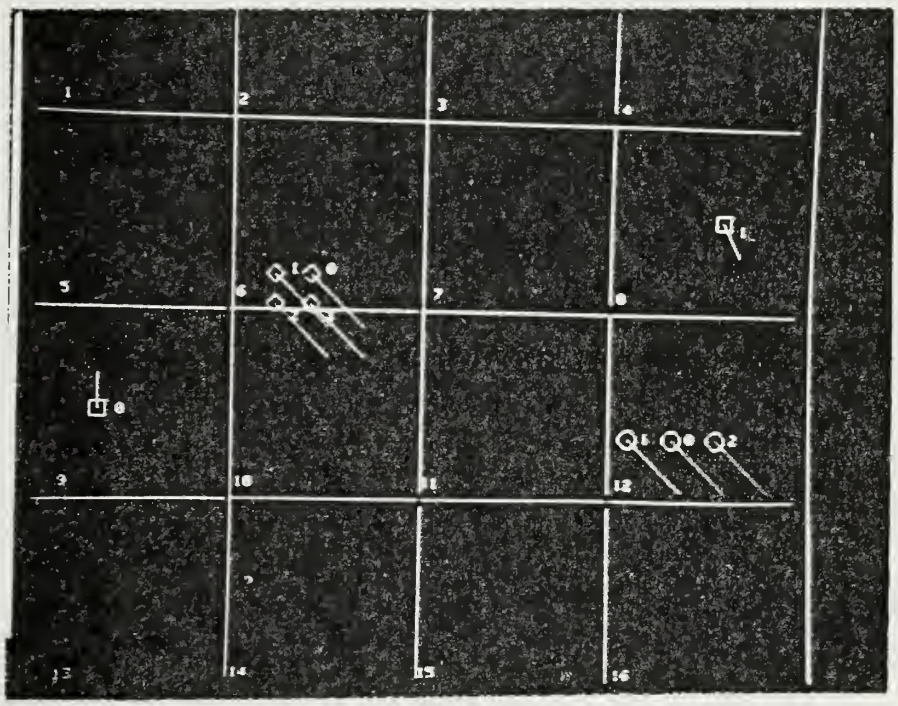
The operator has the responsibility to analyze the data presented, interact with the display system as necessary, to determine both the overall surface contact profile and any possible threat to "ownship." The analysis is performed by utilizing the primary plasma display as the main source of information. The visual information presented provides the operator with the necessary information to take action.

The action taken, if any, develops in the following logical sequence. The operator identifies a potential threat at the primary plasma display. The operator then uses the touch-panel feature to plot the threat relative to "ownship" at the secondary plasma scope (see figure 11). Figure 12 illustrates the secondary plasma display of the plot showing the threat's position relative to "ownship."



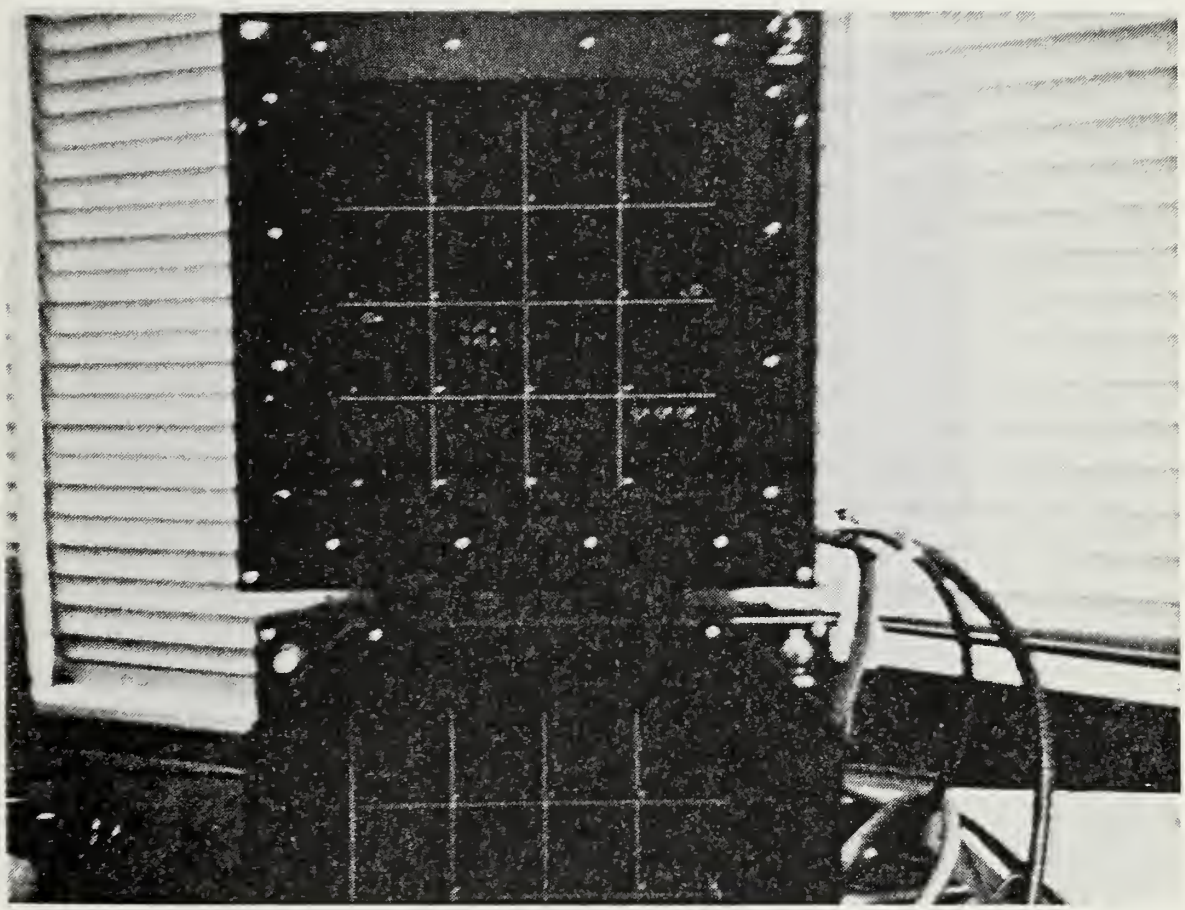
PRIMARY PLASMA SCOPE

FIGURE 7



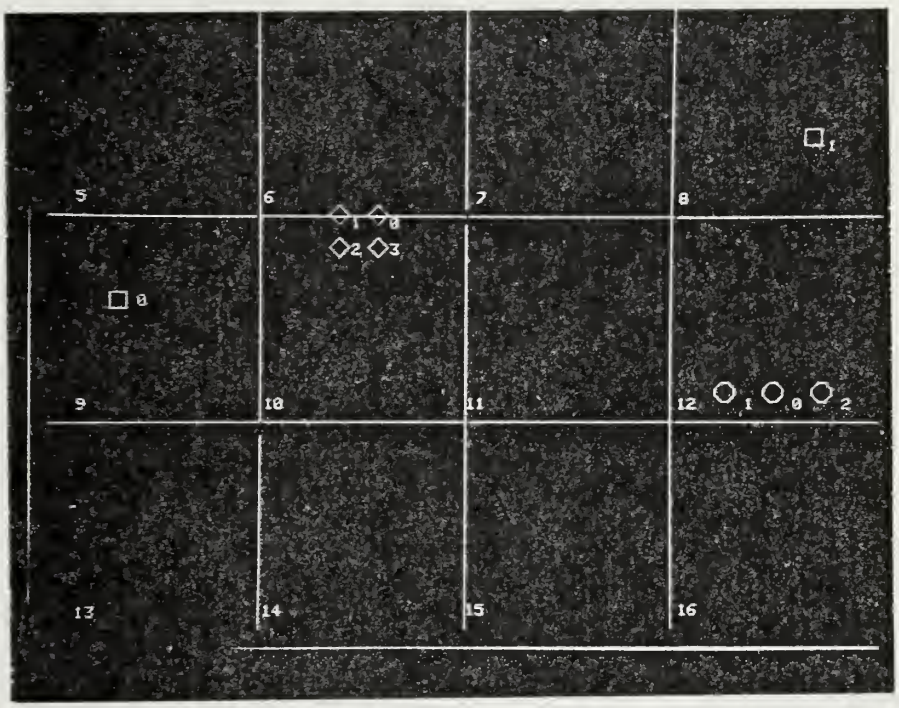
PRIMARY PLASMA DISPLAY

FIGURE 8



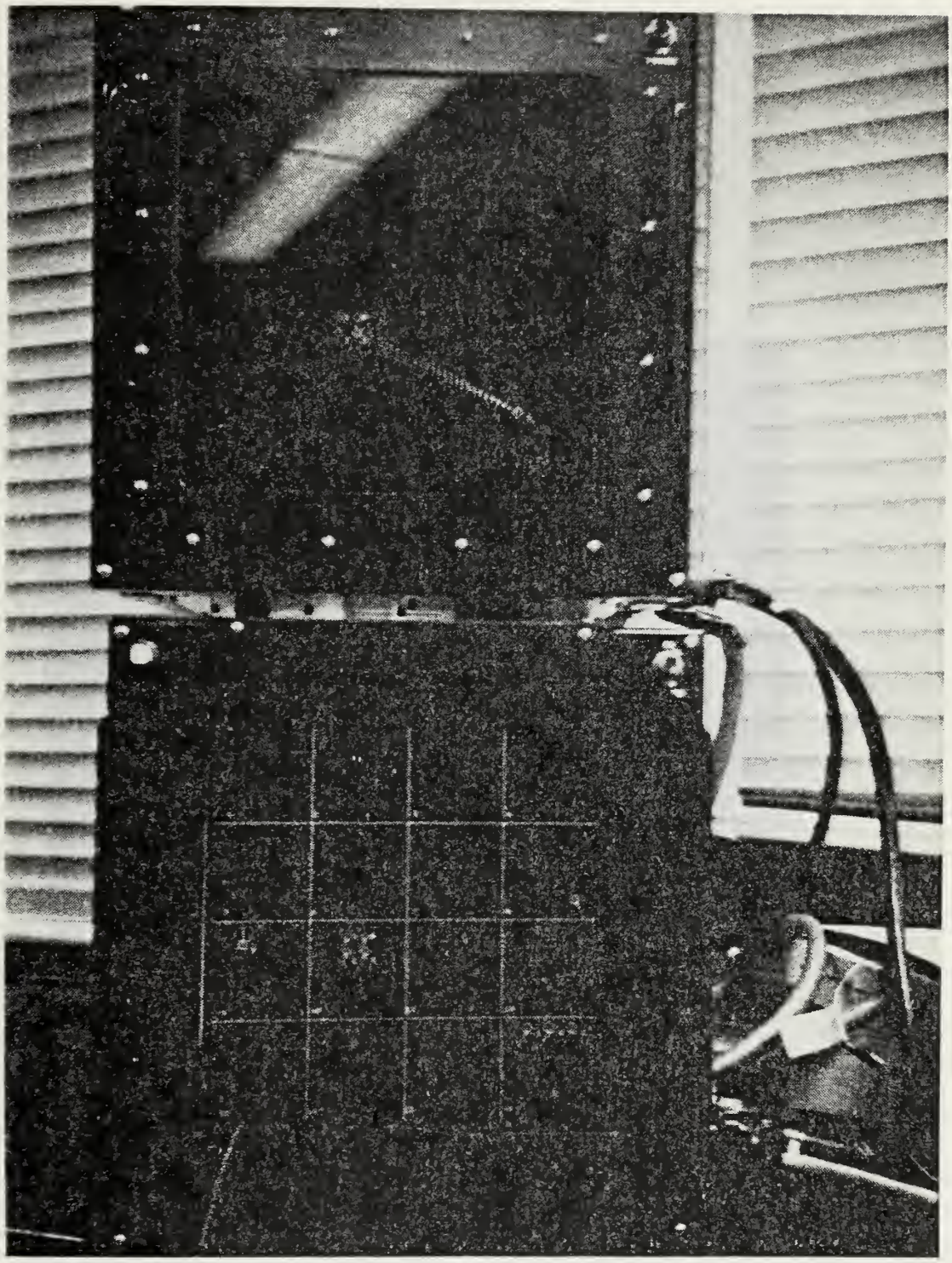
SECONDARY PLASMA SCOPE

FIGURE 9



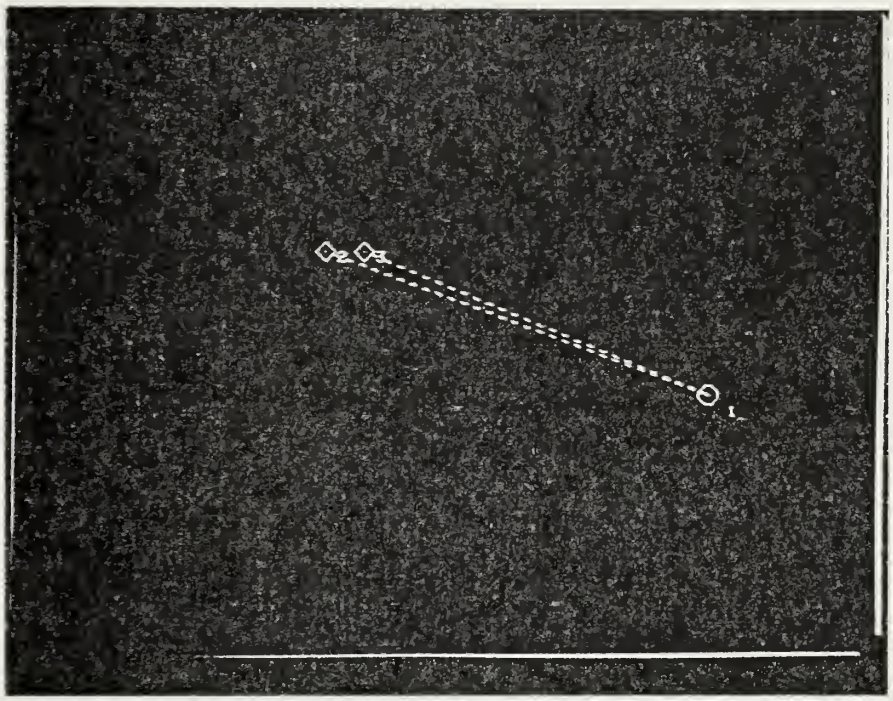
SECONDARY PLASMA DISPLAY

FIGURE 10



TOUCH-PANEL OUTPUT AT SECONDARY PLASMA SCOPE

FIGURE 11



DISPLAY OF THREATS RELATIVE TO 'OWNSHIP'

FIGURE 12

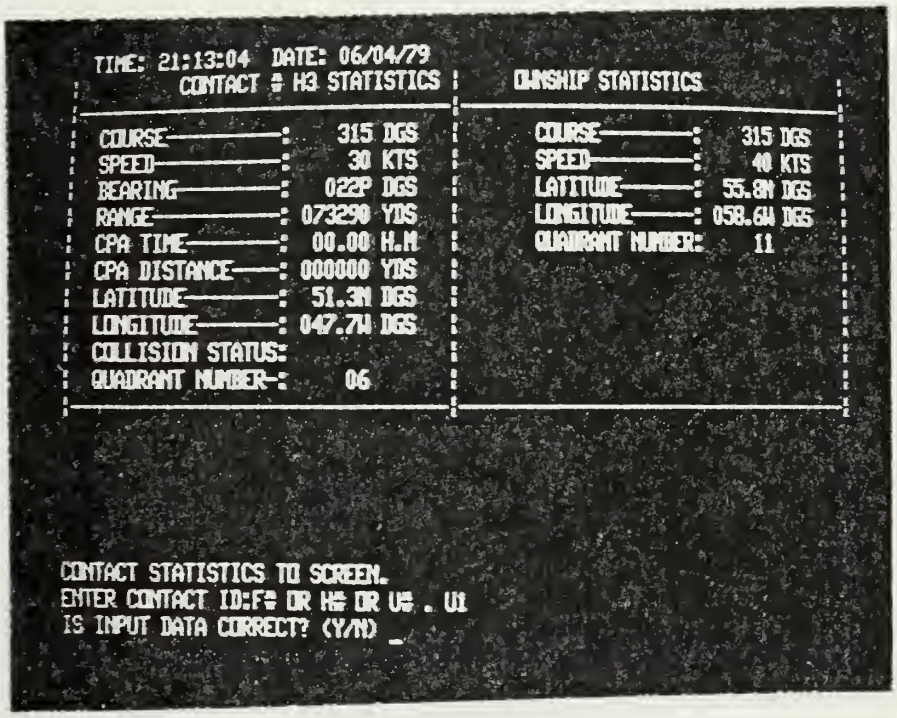
At this point the operator is able to zoom-in on the specific threat contact's characteristics by executing a command option. Figure 13 illustrates the execution of the command option and a possible result at the CRT screen.

At any time the operator can obtain or request a hard-copy of the most recent general or specific contact characteristics for dissemination. The format of the hardcopies is exactly the same as the ones presented at the CRT screen. The operator may also at any time reset time and date, and select the display mode and hardware device. The execution of the command to reset hardware devices is shown in figure 14.

C. DESIGN OBJECTIVES

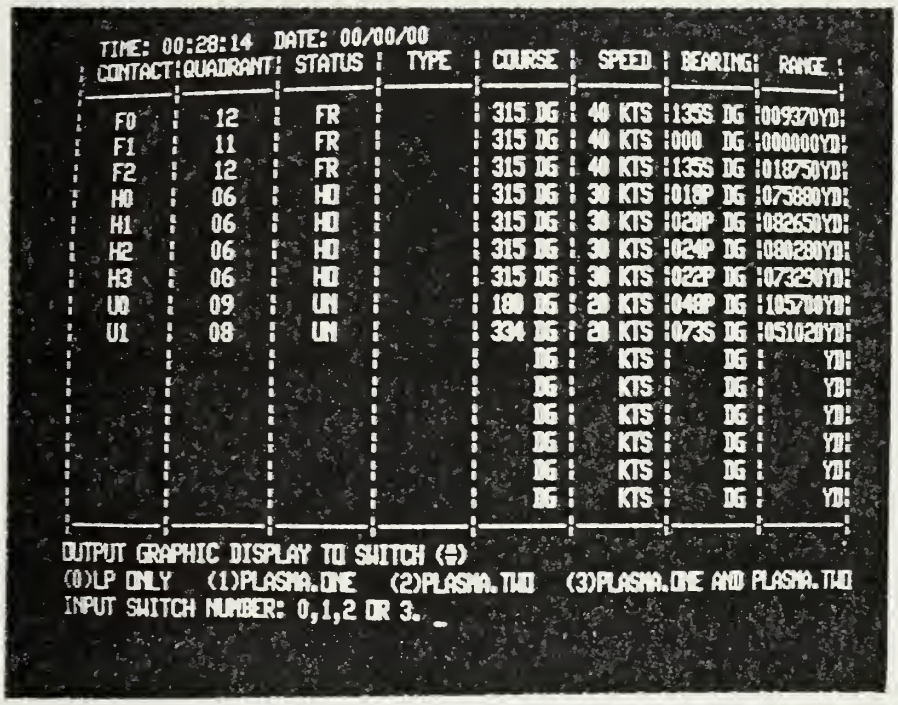
The graphical and alphanumeric type of information to be dipslayed at the display system will be a mix of inter-related graphical and alphanumeric contact characteristics. This information reflects the Surface Contact Profile of any 80 by 80 square mile area, with the maximum capability of displaying information of 10 Friendly contacts, 10 Hostile contacts, and 10 Unknown contacts simultaneously. The 80 by 80 square mile area will be divided into 20 by 20 square mile quadrants to provide for visualization and a basis for operation interaction.

The minimum information required to maintain the Surface Contact Profile at the display system is as follows (for each contact):



SPECIFIC CONTACT QUERY AND RESULT

FIGURE 13



HARDWARE REASSIGNMENT

FIGURE 14

- Latitude
- Longitude
- Course
- Speed
- x-coordinate of display
- y-coordinate of display
- Quadrant
- Range
- Bearing
- Collision status
- CPA Time
- CPA Distance

The display system will have the following functional capabilities:

- Remote processing must include capability to minimize time and length of data reception;
- Data reception must be on an interrupt basis in order not to circumvent the processing and formatting of data and the creation of local data bases;
- Graphical and statistical display modes to present the surface contact profile of the operational area;
- An adequate man-machine interface must be implemented to provide real-time (response) interaction with the system;
- The real-time (response) interaction must provide for a zoom-in capability for any contact of interest;
- Levels of correctness at the computer and operator levels must be achieved to minimize operator errors; and

- Hardware devices and the software displays must be driven independently to allow for maximum system flexibility and redundancy. This will allow the operation of the system in a degradated mode.

D. TECHNOLOGICAL BASE

Minicomputers, Micro-processors, Microcomputer and Plasma graphic display devices form the core of the technological base on which the system is based.

Minicomputers are designed as powerful computational tools. Among their major features are fast control processors with choices of semiconductor and core memory, floating point processing, sophisticated memory management schemes and an extended I/O capability.

Minicomputers such as the PDP-11/50 are designed for high speed real time applications and for large multi-user and multi-task applications. The PDP-11/50 Minicomputer, because of its computational and I/O capabilities, in conjunction with its availability at the Naval Postgraduate School was selected as the main frame computer of the system.

Microprocessors, in general, are not complete computers, but Central Processor Units (CPU) implemented with, say, one to ten large-scale-integrated-circuit chips. Large Scale Integration (LSI) chips are comprised of 1,000 or more gates; many LSI chips hold over 6,000 gates or a "Complete Central Processor."

The term "Micro-computer" is even less well defined. This is a small-stored program computer comprising memory

and input/output circuits together with a Microprocessor CPU.

Microcomputers with less than 2000 words of memory cost between $25 and $1,000 in quantities of 100. Practically all are special-purpose computers used as system components.

Interface design and programming make the mass-produced microcomputers and/or minicomputers into new special-purpose dedicated machines.

The Intellec Microcomputer Development System (MDS) is a complete, coordinated computer system, designed around Intel's 8080 microprocessor. The MDS has a 2 micro-second instruction cycle, a repertoire of 72 powerful instructions, unlimited subroutine nesting, and a versatile interrupt scheme.

The Microcomputer Development System (MDS) was selected as the host computer for the Display system because of its 8080 microprocessor, its memory capabilities, its interrupt mechanism, and its extended I/O capabilities.

The graphical display device selected was the 2500 Plasma-scope Gas Discharge System.

The plasma panel contains 262,144 individual dots which are capable of being discretely addressable in terms of selecting specific x and y coordinate values for excitation; e.g., to create or extinguish light. Plasma Panels do not require refresh and, once a particular point on the display is "turned-on", it continues to glow until "turned-off."

The CRT device selected for alphanumeric display of informational data and utilization as the Man-Machine Interface device was the DATAMEDIA ELITE 2500 Video Terminal. The DATAMEDIA is a stand-alone terminal containing an alphanumeric display, keyboard, storage, control logic and a asynchronous/synchronous communications interface.

The data link selected (2400 baud) for the system was an asynchronous serial/communication line based on EIA standard RS-232-C specifications. The link was selected because it was hardware compatible and was available at N.P.S.

The Intel's Microcomputer Development System (MDS) hosts the ISIS-II operating system, which supports 8080 assembly language and the PL/M-80 high-level language. Because of the complexity and size of the Software package anticipated, the PL-M/80 high level language was chosen for its multiple and powerful features.

The PDP-11/50 Minicomputer hosts the UNIX operating system which supports high level languages such as Fortran, Pascal and C. Since "C" is the system's language and it has the largest set of library functions, this language was chosen as the high level language to be used at the PDP-11/50. A more detailed description of the hardware components is given in Chapter IV and its associative appendices.

E. DEVELOPMENT PLAN

Upon completion of a 'top-down analysis' of the effort required to implement the system, the project was divided

into three major areas:

1. Hardware and Software functions and capabilities to be developed for the PDP-11/50 Minicomputer.

2. Hardware and Software functions and capabilities to be developed for the MDS Microcomputer.

3. Hardware and Software interfaces required to provide computer to computer communications between the PDP-11/50 Minicomputer and the MDS Microcomputer.

From the analysis, a critical development path was determined creating a development order (priority, time basis) for the three major areas of the project.

The most critical project area was the Software and Hardware interfaces for computer to computer communications. There did not exist any systems compatible interface (hardware or software) between an MDS Microcomputer and the PDP-11/50 Minicomputer. Further complicating the effort was the fact that the MDS microcomputer is an 8-bit word machine, hosting the ISIS-11 operating system supporting the PL/M-80 language, and the PDP-11/50 is a 16-bit machine hosting the UNIX operating system supporting the "C" language.

At completion of the interface, the effort was directed to the other two project areas in a Flip-Flop manner allowing interim testing of the partial system configuration. Greater emphasis was placed on the Hardware and Software development at the MDS end, because of the greater proportion of development effort required in this project area. The iterative Flip-Flop development was highly desirable to provide feedback

to the development process. The iterative process allowed the development of an adequate test data set to test and validate the system design upon completion.

The Project development was evaluated under the following guidelines:

- All Hardware components and interfaces were tested on a stand-alone basis before incorporating them into the system design being implemented.

- Software development was approached in such a manner as to allow testing at the procedure and module level.

- Upon completion of the System design implementation, the system was evaluated utilizing a test data set to demonstrate system capabilities compared against design objectives.

III. DISPLAY MODES

A. GENERAL INFORMATION

The design approach taken in the implementation of the display modes was a mix of complementary graphical and alphanumeric types of information.

The strategy was to present graphical data at the plasmascope, and alphanumeric data at the CRT screen or the line printer. Operator interaction was provided thorugh the CRT keyboard.

The interaction was designed to provide the operator with the necessary capability to query the system, to obtain real-time general and individual contact statistics. This could be done with full system operation and in a degradated mode. The operator Command Options are given in table 1. For detailed description of the Command Options see appendix A.

In order to provide correctness in the interaction of the operator with the system, a method to check the operator's input was implemented,

B. COMMAND OPTIONS: CORRECTNESS

Each Command option has a built-in procedure whose function is to allow only correct inputs in the command. The parameters of each command are bounded within certain ranges that the operator must respect, if not, the following message will appear at the CRT screen:

COMMAND OPTIONS

B.....; DISPLAY GENERAL DATA STATISTICS TO CRT SCREEN.

G.....; DISPLAY GENERAL DATA STATISTICS TO LINE PRINTER.

S.....; DISPLAY GENERAL DATA STATISTICS PER DATA RECEPTION.

L-F#,L-H#,L-U#..: DISPLAY CONTACT STATISTICS TO SCREEN.

P-F#,P-H#,P-U#..; DISPLAY CONTACT STATISTICS TO LINE PRINTER.

W.....; DISPLAY CURRENT TIME AND DATE TO SCREEN.

T.....; RESET DATE AND TIME.

R.....; DATA RECEPTION VERIFICATION TO SCREEN.

Z.....; SET STATUS OF PLASMA (lAND2) AND LINE PRINTER.

M.....; DISPLAY COMMAND OPTIONS TO SCREEN.

N.....; DISPLAY COMMAND OPTIONS TO LINE PRINTER.

PLASMA TOUCH PANEL

TABLE 1

INPUT DATA INCORRECT: ENTER CORRECT DATA.

This message will remain in the CRT screen until the correct data is entered and only then the operator can continue with the command.

After a Command function is performed, the system will query the operator with the following message:

IS INPUT DATA CORRECT? (Y/N)

The operator has the option to complete the command by inputting a 'Y' or exiting the command state with no action being taken by inputting a 'N'. A 'YES' or a 'NO' will be printed to the CRT screen reflecting the operator's choice. In case of a 'Y', the Command is executed, in case of a 'N', the Command state will be reinitialized automatically to request Command input parameters from the operator, disregarding his last input.
This process will continue until the input data is accepted by the system and by the user.

C. GRAPHICAL DISPLAY MODE

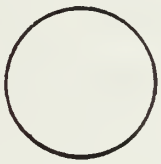
The graphical data presented at the primary plasma screen is a geographic region representing an absolute area 80 by 80 miles, partitioned in 16 numbered quadrants each 20 miles square, and symbolic representation of friendly, hostile and unknown contacts.

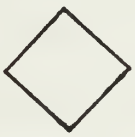
The geographic region represented in the screen is determined by the PDP-11/50 which has the responsibility for

establishing the base longitude and latitude of the tactical environment. The sixteen 20 mile square quadrants remain fixed (with respect to the screen) to provide for enhanced visual interpretation of the data and to provide a grid pattern for the user interaction with the touch panel device.

All of the above applies to the secondary plasma device, except for the touch-panel capability (no touch - panel device installed at the secondary plasma).

The symbolic representation of friendly, hostile and unknown contacts are as follows:

-  FRIENDLY CONTACT

-  HOSTILE CONTACT

- UNKNOWN CONTACT

All the sumbols had an adjacent numeric Id (0-9) representing the order of detection of the contact relative to its contact set. Each of the contact types; friendly, hostile and unknown defines a contact set.

The symbolic representation and the numeric ID of each contact set are displayed at the primary and secondary plasma devices to denote contact position within the geographic region.

The representations of contact speed and course is restricted to the primary plasma screen. The representation

of contact course is given by a vector-tail which orginiates at the center of the contact symbol, with its length determined by the contact speed (0 to 40 knots).

An illustration of a primary display is shown in Figure 8. An illustration of a secondary display is shown in Figure 10.

D. ALPHANUMERIC DISPLAY MODE

In order to be able to display concurrently the alphanumeric statistical data and allow communications of the operator with the system via the command options, the CRT screen was partitioned.

The 25 line screen was divided into two sections, the first 19 lines were allocated for alphanumeric data, and the last 6 lines were allocated for operator communications.

The alphanumeric data is presented at the screen in Table format, representing the General Data characteristics (all contacts), and a specific Contact characteristics also showing ownship characteristics.

An illustration of the General Data Statistics is shown in Figure 15.

An illustration of the Specific Contact Statistics is shown in Figure 16.

E. DATA ELEMENTS

The data elements used in the presentation of the alphanumeric data, once processed, produce a variety of information which defines the following relative to 'ownship':

- all Contacts

  i.e. General Data characteristics

- A Specific Contact

  i.e. Contact data characteristics.

Appendix B describes the data elements in detail.

ILLUSTRATION OF GENERAL CONTACT STATISTICS

TIME: 14:12:21 DATE: 05/09/79

CONTACT	QUADRANT	STATUS	TYPE	COURSE	SPEED	BEARING	RANGE
F0	16	FR		063 DG	20 KTS	027S DG	009370YD
F1	16	FR		063 DG	20 KTS	000 DG	000000YD
F2	16	FR		063 DG	20 KTS	027S DG	018750YD
H0	10	HO		045 DG	10 KTS	122P DG	076590YD
H1	10	HO		045 DG	10 KTS	125P DG	083160YD
H2	10	HO		045 DG	10 KTS	129P DG	080460YD
H3	10	HO		045 DG	10 KTS	127P DG	073650YD
U0	09	UN		180 DG	20 KTS	132P DG	122410YD
U1	08	UN		334 DG	20 KTS	038P DG	057580YD
				DG	KTS	DG	YD
				DG	KTS	DG	YD
				DG	KTS	DG	YD
				DG	KTS	DG	YD
				DG	KTS	DG	YD
				DG	KTS	DG	YD

FIGURE 15

ILLUSTRATION OF SPECIFIC CONTACT STATISTICS

TIME: 14:12:21 DATE: 05/09/79

CONTACT # H1 STATISTICS

COURSE----------:	045 DGS
SPEED----------:	10 KTS
BEARING----------:	125P DGS
RANGE----------:	083160 YDS
CPA TIME----------:	00.00 H.M
CPA DISTANCE---------:	000000 YDS
LATITUDE----------:	54.2N DGS
LONGITUDE----------:	048.5W DGS
COLLISION STAUTS-----:	
QUADRANT NUMBER------:	10

OWNSHIP STATISTICS

COURSE----------:	063 DGS
SPEED----------:	20 KTS
LATITUDE----------:	60.4N DGS
LONGITUDE---------:	060.3W DGS
QUADRANT NUMBER---:	16

FIGURE 16

IV. HARDWARE COMPONENTS

Given below is a list of the Hardware components used in this study and discussed in this chapter.

1 PDP-11/50 Minicomputer

1 MDS Microcomputer

2 2500 Plasma-Scope Gas Discharge Display System

1 Plasma-Scope Touch Panel

1 Datamedia Elite Video Terminal

1 Line Printer

A. MICROCOMPUTER DEVELOPMENT SYSTEM "MDS" DESCRIPTION

The Intellec microcomputer development system (MDS) is designed around Intel's popular 8080 microprocessor. The MDS utilizes the INTEL SYSTEMS IMPLEMENTATION SUPERVISOR (ISIS-II), as its operating system in conjunction with the INTELLEC system "Firmware Monitor" package.

The 8080 has a 2-μsec instruction cycle, a repertoire of 72 powerful instructions, unlimited subroutine nesting, and a versatile interrupt scheme. The 8080 supports up to 65,536 (64K) words of memory and up to 512 I/O devices (256 input, 256 output). The basic hardware configuration includes 16,384 (16K) bytes of Random-Access-Memory (RAM), and six fully implemented I/O interfaces to:

- a Teletype (including its paper tape reader)
- a CRT terminal (or other compatible device),
- a high-speed paper tape reader,

- a high-speed paper tape punch,
- a line printer, and
- Intel's Universal PROM Programmer.

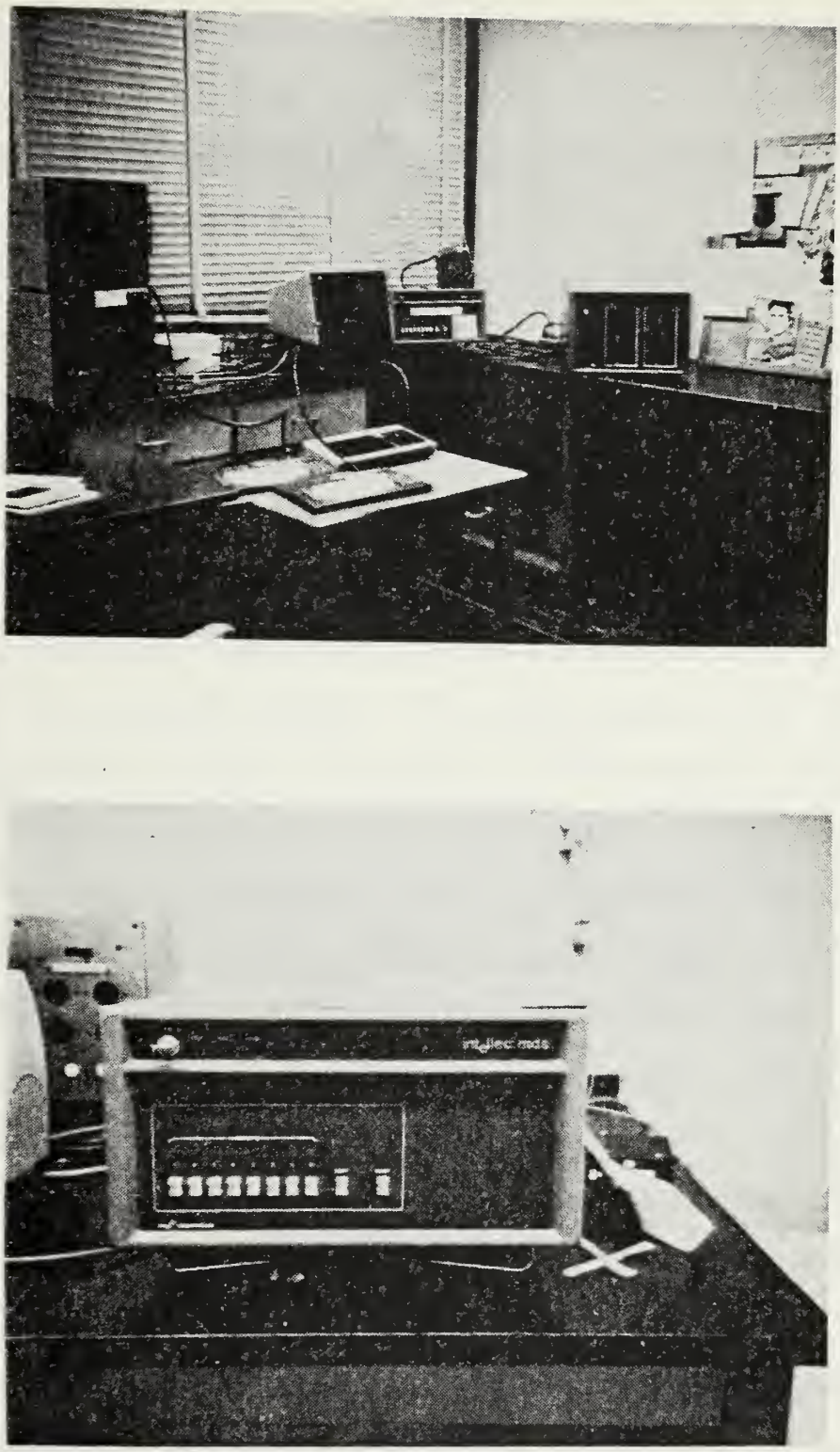
The "standard" configuration of the overall computer system consists of the MDS microcomputer, a dual-diskette drive (a quarter million bytes per floppy disk), a CRT and/or teletype for man-machine interface, a resident high-level PL/M-80 compiler, and a resident assembly language 8080/8085 macro assembler, as shown in figure 17.

B. PLASMA PANEL DESCRIPTION

This section describes the SAI Technology Company's Model 2500 Plasma-scope Gas Discharge Display System, which is capable of displaying alphanumeric characters and/or graphics. The plasmascope also features several configuration options to provide full capability for interfacing with a keyboard and various parallel and serial computer interfaces such as:

- The Interface I/O.
- The Display Buffer.
- The Vector Generator.
- The Character Generator.
- The Manual-Entry Keyboard.

The plasma panel contains 262,144 individual dots which are capable of being discretely addressable in terms of selecting specific x and y coordinate values for excitation; e.g., to create or extinguish light. The panel is normally driven by selecting parallel groups of lines on one axis (Y)



MDS MICROCOMPUTER CONFIGURATION

FIGURE 17

and scanning on the other (X). This operation provides displays of alphanumeric data using a dot matrix/format for characters and symbols. Also, by selecting single element location in coordinated fashion, graphics can be created on the display surface.

More specifically, the plasma panel consists of two panels of clear glass each of which has embedded parallel electrodes that are appropriately separated. The panels, aligned with the electrodes at 90 degrees, are separated by a dielectric and space seal as shown in picture 18. This spacer area is filled with a neon-based gas.

In use, each electrode is sequentially activated with an a.c. sustaining voltage. The amplitude of this voltage is controlled so that a breakdown, which causes localized ionization, occurs only at an intersection where the sustained voltage is augmented with an additional appropriate voltage. The ionized gas emits visible light and is maintained in this state by the sustained signal; thus, inherent memory exists. To erase this spot of light, a reverse polarity signal is placed on the electrode pair at the appropriate time; this results in a net reduction of the voltage below the sustaining level and the subsequent collapse of the ionization field.

The Model 2500 Plasmascope has the following interface capabilities:

- Parallel I/O Buffer, 16 bits.
- Differential I/O Buffer.

PLASMA SCOPE PANEL CONSTRUCTION

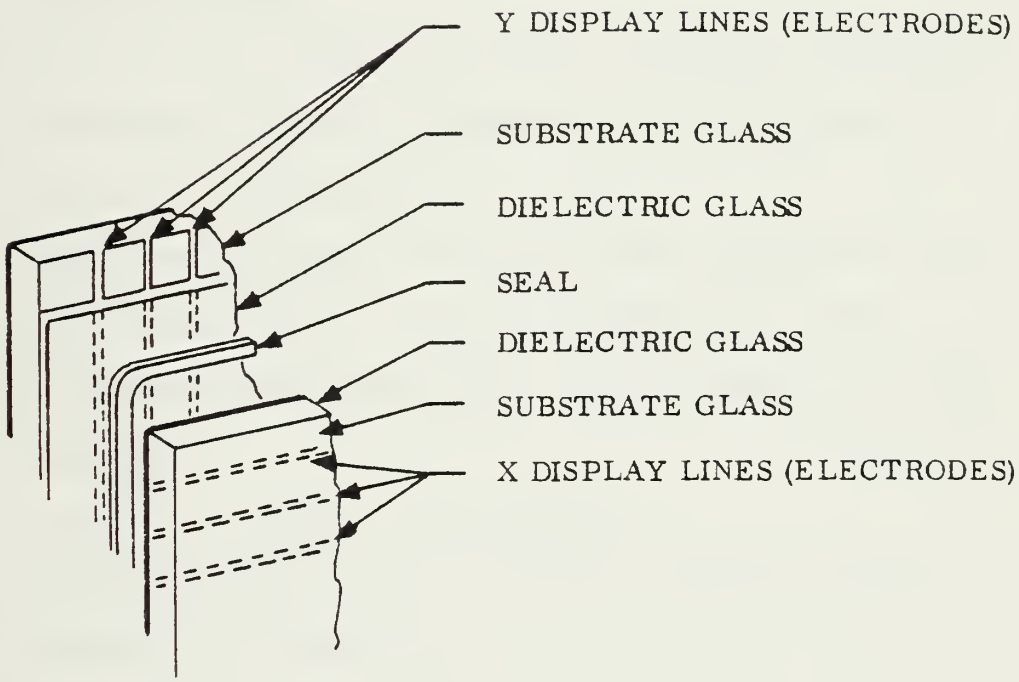


FIGURE 18

- Serial I/O Buffer.
- Data Channel Controls.
- Synchronous Interface.
- Asynchronous Interface.
- NTDS - 3V I/O

The Plasmascope has the following advantages over the conventional CRT display:

- No filaments or heaters.
- No external components such as magnetic deflection coils or yokes.
- No delicate precisely aligned internal components.
- Inherently digital, thus requires no digital to to analog conversion.
- Much lower volume and weight when compared to an equivalent viewing area available in a CRT.
- Inherently stronger than a large evacuated glass envelope.
- No refresh memory requirements.
- No brightness variation between characters or elements of characters.
- No jitter or extraneous noise.

C. PLASMASCOPE TOUCH PANEL DESCRIPTION

The touch panel is an input device for Plasmascope which allows the operator to touch the display panel and input positional information to the computer. The touch panel uses a crossed array of light beams projected just above the

display surface. When an x and y beam is broken by an obstacle such as a finger, the panel inputs the x-y address to the computer. The panel then waits until the finger is repositioned before sending a new address.

There are 16 horizontal and vertical light beams that create a grid pattern of 256 positions which can be identified by the touch panel logic; this logic transforms this positional data to an eight bit data word.

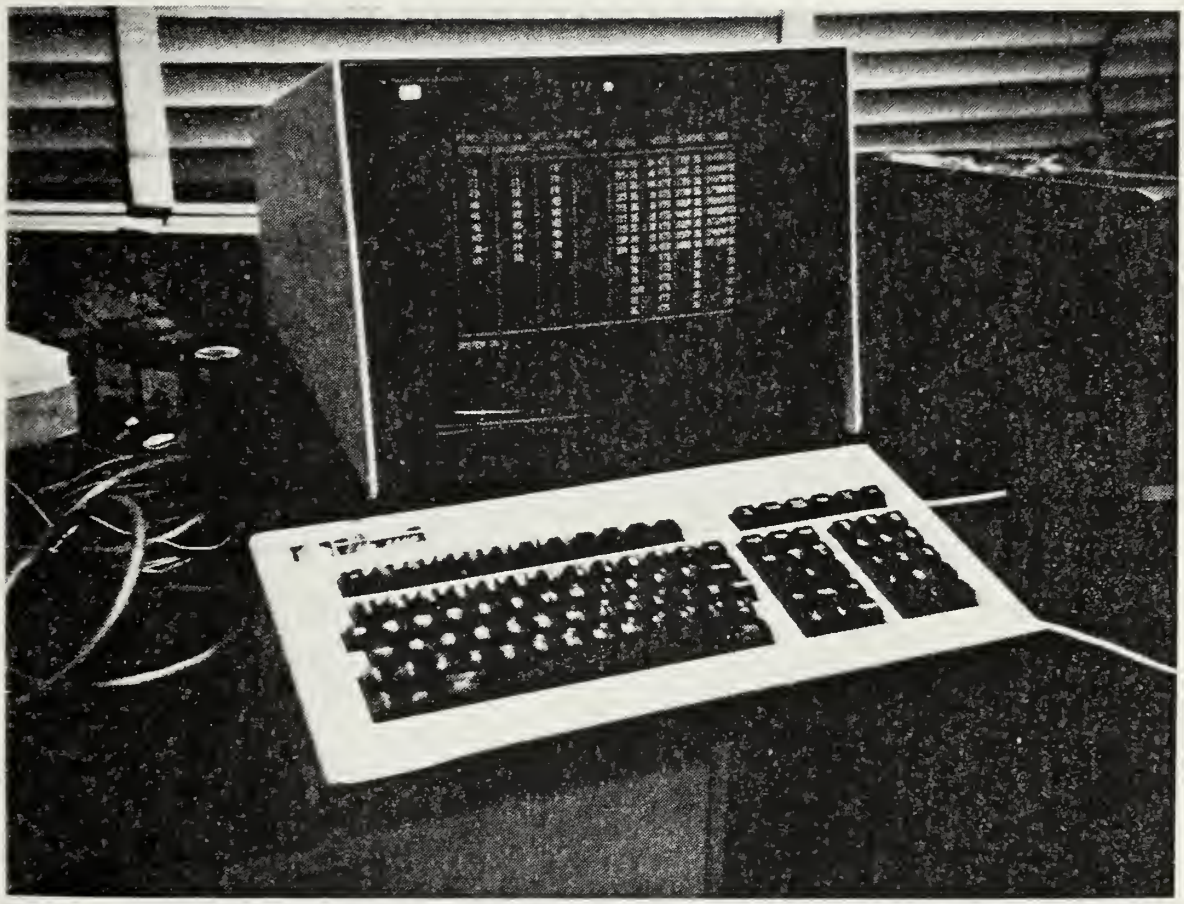
The word consists of 4 bits representing the horizontal position and 4 bits representing the vertical position (x and y coordinates respectively, referenced to the left upper corner). These two 4-bit nibbles in conjunction with the touch-panel status bit, makes the positional information available to the user for any compatible I/O device.

D. DATAMEDIA ELITE 2500 TERMINAL DESCRIPTION

The DATAMEDIA Elite 2500 Video Terminal (shown in Figure 19) is a stand-along terminal containing an alphanumeric display, keyboard, storage, control logic and a synchronous/asynchronous communications interface.

The Elite 2500 can receive at data rates from 50 to 9600 baud synchronous or asynchronous with a screen capacity of 1920 characters.

The Elite 2500 can store and identify 128 ASCII characters. The standard display format is 80 character line by 25 lines. Each character can be stored as a form field character or Blink field character, or both. All characters are formed on a 5 x 7 dot matrix.



DATAMEDIA ELITE 2500 VIDEO TERMINAL

FIGURE 19

The cursor, which is an underline, will identify the position on the screen. The next character received will be entered.

The DATAMEDIA Elite 2500 is an ideal CRT terminal because of its extended set of "control functions" and the following device attributes:

- quiet operation
- editing plus roll mode
- 50 to 9600 baud
- 80 characters per line
- no end of line hang ups
- protected field
- computer derived or high light field (blink)
- addressable cursor
- added carriage time with printer transmit
- good reliability
- electronic keyboard

E. PDP-11/50 MINICOMPUTER DESCRIPTION

The PDP-11/50 is a powerful 16 bit minicomputer of the PDP-11 family of PDP-11 processors, ranging from board microcomputers to full multipurpose computer systems.

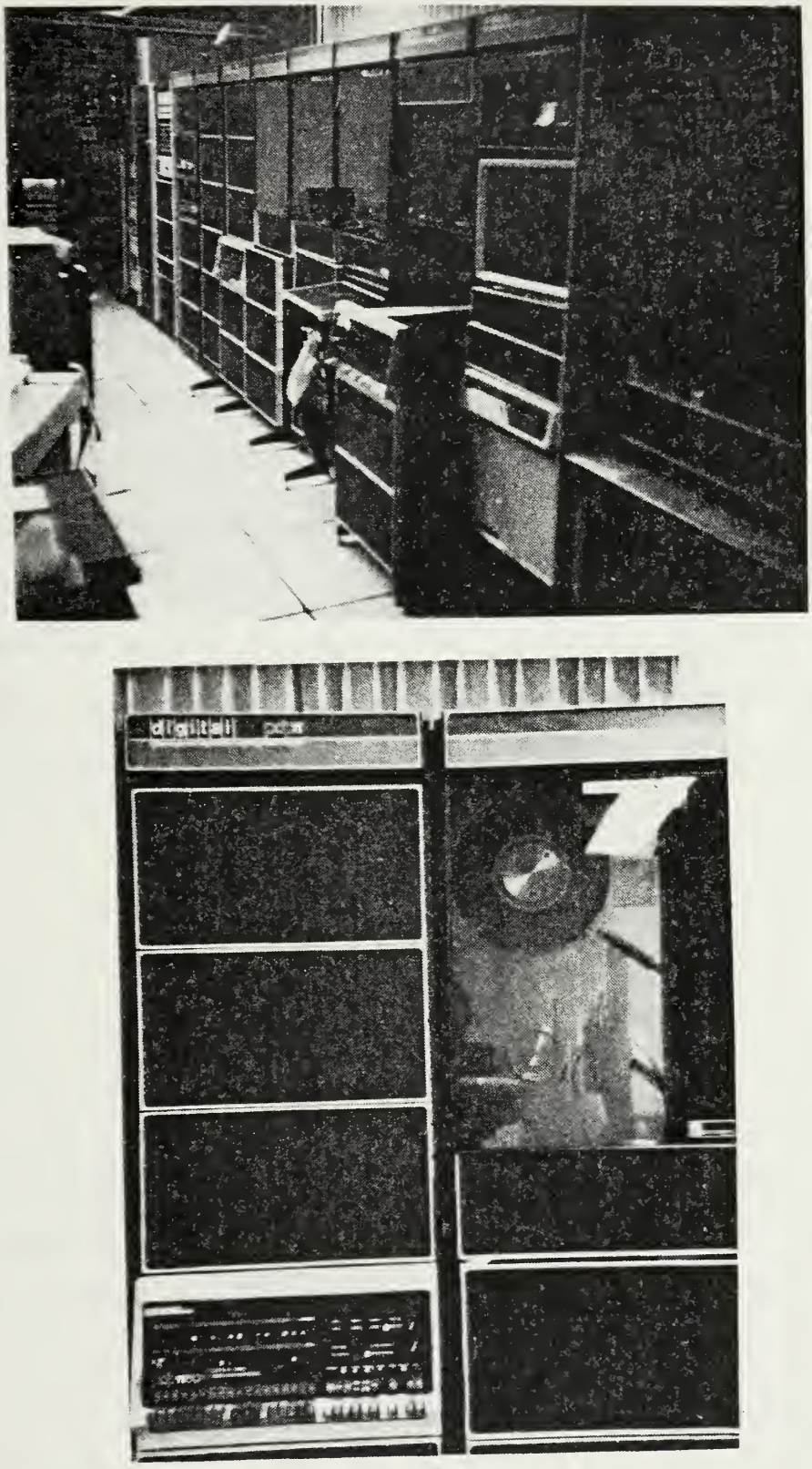
All of the processors are built upon a common architecture, that uses a similar instruction set and input/output systems. The programs developed on one PDP-11 processor may therefore run on any other PDP-11 processor without major conversions. Hence all PDP-11 machines are architecturally similar and hardware and software upwards compatible.

The PDP-11/50 is designed as a powerful computation tool for high-speed real-time applications and for large multi-user, multi-task applications, requiring up to 124 K words of addressable memory space. It will operate with solid state and core memories, and includes many features not normally associated with 16-bit computers. Among its major features are a fast central processor with choices of semi-conductor and core memory, an advanced FLOATING POINT PROCESSOR, and a sophisticated memory management system.

The 11/50's basic I/O interface include the following:

- alphanumeric display
- teletype
- high-speed line printer
- card reader
- synchronous and asynchronous communications devices
- storage devices. Storage devices range from small reel magnetic tape units to mass storage magnetic tapes and disk memories. A large number of storage devices, in any combination, may be concurrently connected to the PDP-11/50 systems.

The configuration utilized in the MDS-PDP interface involves a PDP-11/50 system running under th UNIX operating system in a multi-user mode with the overall hardware system configuration as shown in figure 20.



PDP-11/50 MINICOMPUTER CONFIGURATION

FIGURE 20

V. MDS - PDP INTERFACE

A. GENERAL INFORMATION

The computer to computer interface involved the establishment of a communication/data link between the Intellec Microcomputer Development System (MDS) and the Digital Equipment Corporation (DEC) PDP-11/50 minicomputer system. The interface required asynchronous serial data/communication (based on EIA standard RS-232-C line) data link, and a Handler ("data" flow controller) at each respective computer. The handlers were required in order to convert input data to appropriate system format(s) for assimilation into the system(s) environment. The handling involved the initiation of a system response to manipulate the data set as required; i.e.,

- creation of a file
- updating of a file
- process commands
- systems calls
- initiation and termination of communications.

The interface provides the capability to edit, compile, and execute files in the PDP-11/50 minicomputer and in the MDS microcomputer. The interface provides for the transfer of files in three operational modes. The first two modes consist of a one way transfer of a file from either the MDS to the PDP-11/50 or the PDP-11/50 to the MDS. The third mode

of operation involves the "round-robin" transfer of a file initiated at either the MDS or PDP-11/50 to the other and after completion of interaction the original updated file is transferred back to the originator. The most significant operational aspect of this interface is that it provides the combined system development capabilities of both; the Intellec Microcomputer Development System (MDS) and the Digital Equipment Corporation (D.E.C.) PDP-11/50 minicomputer systems, to a user of either or both of the systems.

For a detailed description of the Data link, MDS hardware modifications and PDP software modifications see appendix C.

B. SOFTWARE COMPONENTS: FUNCTIONAL DESCRIPTION

1. MDSPDP PL/M-80 Program

MDSPDP operates by maintaing two buffers, one for the characters typed at the CRT, and the other for the characters sent to and from the MDS microcomputer. In each buffer, characters are arranged as a FIFO queue. The CRT buffer is 200 bytes long. The PDP buffer is 9 K bytes long, beginning at memory location D400 Hex and ending at the memory location F800 Hex which is the last memory location available for storage. This PDP buffer can be expanded up to 40K by changing the base of the buffer as needed. When the CRT buffer is full and the operator tries to type more characters, MDSPDP reacts by sending five (5) "Beep" characters to the MDS CRT. When the PDP buffer is full and the PDP

tries to send more characters, MDSPDP reacts by sending an error message to the MDS CRT, terminating receive state and reentering neutral state. If this is the case the PDP file must be partitioned within the bounds of the buffer.

MDSPDP uses the ISIS-II system calls to transmit byte data from the PDP and CRT buffers to the PDP-11/50, and, to and from the floppy disk to the MDS system. The ISIS-II operating system will issue general error messages concerning software and/or hardware faults to the MDS CRT.

The main routine in the MDSPDP handler is an infinite loop which performs a polling operation on the status bits of the TTY usart and the CRT usart; then depending on the system's state, appropriately inputs or outputs data to and from the CRT or PDP buffers.

The critical feature of the MDSPDP program is asynchronous timing of data communications, program execution, system control, and handshaking, between the PDP-11/50 Unix operating system and the MDS ISIS-II operating system. This was done while maintaining man-machine interfaces to the MDS system and to the PDP system trhough the MDS microcomputer.

2. PDPRECEIVE "C" Program

One of the two programs (user mode) written to work in conjunction with MDSPDP is the PDPRECEIVE program which is written in "C", and executes under the PDP-11/50 UNIX operating system. The functions of this program are to act as an input handler for byte data, creation of a file for

the input data, and perform the "handshaking" with the "MDSPDP" program executing under the ISIS-II operating system on the MDS microcomputer.

3. PDPSEND "C" Program

The other program used (user mode) in conjunction with the MDSPDP is the PDPSEND program, which is also written in "C" and executes under the PDP-11/50 UNIX operating system. The function of this program is to act as an output handler for the PDP-11/50 transmitting byte data from an existing file in the PDP to the MDS microcomputer.

C. INTERFACE DEFINITION

The MDS-PDP-11 data communication link is based on the following hardware and software components.

1. PDP-11/50

a) Single input/output port (CRT) to the PDP-11/50 configuration.

b) Software input and output handlers for PDP-11/50: PDPRECEIVE and PDPSEND programs respectively, both programs written in high level language "C" supported by the UNIX operating system.

2. DATA LINE

a) ASYNCHRONOUS 2400 baud serial data/communication line (based on EIA standard RS-232-C line) from the PDP-11/50 system to the Intellec MDS system.

3. MDS

a) CRT input/output port at the MDS system as shown in figure 21. (Local CRT interface to MDS via teletype (TTY) input/output port.)

MDS DATA LINK I/O CONFIGURATION

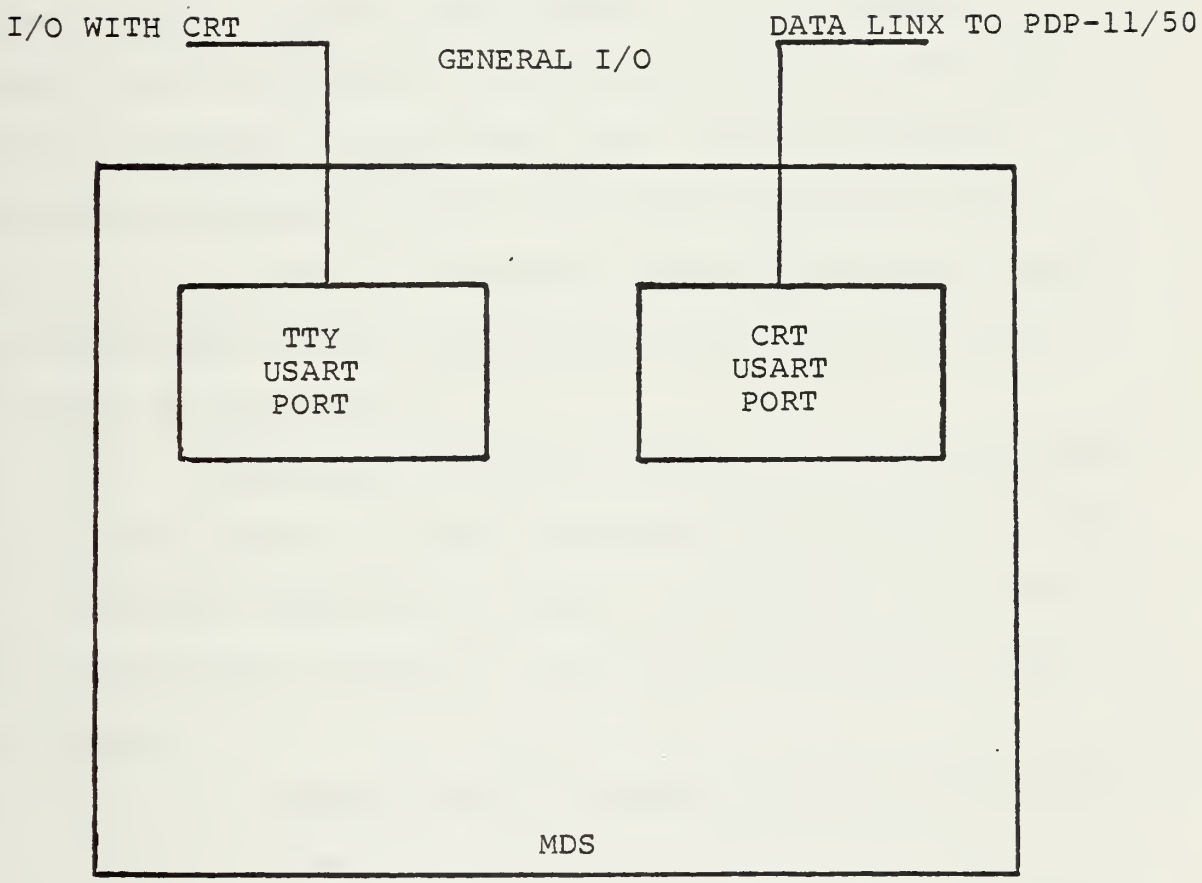


FIGURE 21

b) Software input/output handler for the MDS-PDP data link: MDSPDP program written in high-level language PL/M-80 supported by the ISIS operating system.

In order to establish communications between the MDS microcomputer and the PDP minicomputers; the MDSPDP handler, "MDSPDP," must be executed at the MDS microcomputer system. The purpose of this is to creat the necessary local environment (system parameters, system interfaces, input/output buffers, asynchronous timing, etc.) in order to present the MDS SYSTEM as a CRT terminal to the PDP-11/50 operating system, via the data line. This provides an operator at the MDS system, with log-on capability and access to all system functions of the UNIX operating system (program execution and termination, creation, deletion, updating of files, etc.).

Given that communications have been established, the MDSPDP handler acts as a software switch allowing three (3) different communication modes of operation, and a program termination capability. The state of operation are as follows:

- Netural state: CRT(MDS) to PDP, PDP to CRT (MDS)
- Receive State: PDP to floppy disk via MDS microcomputer.
- Transmit state: floppy disk to PDP via MDS microcomputer.

The Netural state is automatically entered with the execution of the "MDSPDP" handler at the MDS microcomputer. It is in this state that the operator at the MDS system is provided with log-on capability and access to the UNIX operating system.

Once the log-in has been completed, the system will still be in the neutral state, awaiting operator commands to enter receive state, transmit state, stay in neutral state or terminate program.

The receive state provides the MDS system with a data import capability to receive data from the PDP. The MDS microcomputer has the system's responsibility to receive data, store it in core until completion of the data transfer (End-of-file) and, then transfer the data in core to floppy disk and return to netural state.

The transmit state provides the MDS system with a data export capability to transmit data from the MDS system to the PDP. The microcomputer has the system's responsibility to latch (transfer) 128 byte blocks of data from the floppy disk to core, transmit it from core to the PDP, and repeating the process until end-of-file, and returning to neutral state. This is accomplished by the PDPRECEIVE and the MDSPDP programs.

D. PDP-11/50-MDS INTERRUPT DRIVEN DATA TRANSMISSION

In order to create the necessary environment for the display system, concurrent with the transmission and

reception of files between the PDP-11/50 MINI computer and the MDS MICRO computer, interrupt driven data communications and interrupt driven processes were implemented.

The interrupt mechanisms consisted of the occurrence of an internal operating system event such as the completion of a process, the status of the real time system's clock, and the readiness of the PDP-11/50 to communicate data to the MDS microcomputer.

The interrupt driven mechanisms allow the MDS to operate in a remote stand alone basis, while maintaining the capability to respond to "external" events with complete data reception capability. For detailed information about the interrupt driven method see appendix C.

VI. SOFTWARE OVERVIEW

A. GENERAL INFORMATION

The software application package for the System utilized 2 different high level languages; "PL/M-80" in the MDS Microcomputer, and "C" in the PDP-11/50 Minicomputer [Ref. 9,10,11,12,13,14,15,16,17,20,22 and 25].

The software effort for the MDS microcomputer required 70 percent (%) of the project development time for completion. The Software package consisted of 24 major modules, 217,000 bytes of source code and 39,000 bytes of object code.

The Software effort for the PDP minicomputer required 15 percent (%) of the project development time. This Software package consisted of 13 subroutines, 10,000 bytes of source code and 12,000 thousand bytes of object code.

The software development effort consisted of top-down design and bottom-up testing [Ref. 6,7 and 8].

B. DATA STRUCTURES

To establish compatible data bases at each computer, the same data structure format was utilized for both machines. This was done to facilitate the creation and formatting of data at the PDP-11/50 for transmission and reception and building of the data bases at the MDS end. The "structure" statement in PL/M-80 and C was used because of its inherent attributes for building data bases. For additional information

on this powerful statement in each language see references 13, 25. See figure 22 for data structures illustration.

C. M.D.S. DISPLAY SYSTEM SOFTWARE

The development of the software package for the M.D.S. microcomputer evolved the software into functional modules. These modules consist of stand-alone procedures to provide for testing at the procedure and module level. A functional description of each one of the modules used, with its internal subroutines is presented in appendix D.

D. PDP-11/50 SOFTWARE

As stated previously, the integration and interface between the software development packages at both ends, in conjunction with the MDS and PDP-11/50 hardware, provides the functional capabilities of the system. The programming effort at this end was directed to the creation of an algorithm using the facilities of the UNIX operating system. This algorithm provided the appropriate environment and Data Base to input and output 'raw data' through the data link to the MDS system.

A functional description of each procedure is presented in appendix D.

"PL/M-80" DATA STRUCTURE

```
DECLARE SHIP$PLOT (15) STRUCTURE (
          LAT(1Ø) ADDRESS,
          LONG(1Ø) ADDRESS,
          COURSE(1Ø) ADDRESS,
          SPEED(1Ø) BYTE,
          X$BOW(1Ø) ADDRESS,
          Y$BOW(1Ø) ADDRESS,
          QUADRANT(1Ø) BYTE,
          RANGE(1Ø) ADDRESS,
          BEARING(1Ø) ADDRESS,
          COLLISION$FLAG(1Ø) BYTE,
          CPA$TIME(1Ø) ADDRESS,
          CPA$DISTANCE(1Ø) ADDRESS,
          COUNT BYTE ) PUBLIC ;
```

"C" DATA STRUCTURE

```
struct  {
          int lat[10] ;
          int longtd[10] ;
          int course [10] ;
          char speed[10] ;
          int xbow[10] ;
          int ybow[10] ;
          char quadrant[10] ;
          int range[10] ;
          int bearing[10] ;
          char collflag[10] ;
          int cpatime[10] ;
          int cpadist[10] ;
          char count;
        } shipplot[3], *shipptr;
```

FIGURE 22

VII. SYSTEM DEVELOPMENT SUMMARY

The following discussion presents the development of the shipboard tactical-situation display system. The first section describes the development of the Interface capability between the MDS Microcomputer and the PDP-11/50 Minicomputer on a stand-alone basis providing an integrated MDS-PDP Software and Hardware development facility. The second section describes the entire system development effort incorporating the interface described in section A.

A. COMPUTER TO COMPUTER INTERFACE

The computer to computer interface implemented involved the establishment of a communication data link between the MDS and the PDP, utilizing I/O drivers at each end.

The first step taken in the establishment of this interface was to select and physically connect a data line.

Due to the availability of only serial I/O capability compatible to both computers, a 2400 baud EIA standard RS-232-C line was selected. The second step taken was to create the I/O Software drivers, to receive, send and manipulate data to complete the interface.

Because of the different operating systems and application languages at each computer; distinct and language incompatible I/O drives had to be written at each computer. The incompatibility between I/O hardware utilized at each computer, further complicated by word size (8 bit word and 16 bit word

at the MDS and the PDP respectively), created a necessity for extensive manipulation of data. Temporary buffers and extensive computer to computer handshaking by the I/O drivers at each computer were necessary to allow for the creation, transmission and reception of files.

The data manipulation and handshaking required local to the MDS I/O driver was such that the execution time only permitted a maximum data reception baud rate of 2400, rather than the 9600 baud rate initially attempted.

B. HARDWARE AND SOFTWARE COMPONENTS

This section describes the development of the Hardware and Software components implemented at the MDS and PDP-11/50 computers, and their integration into the system.

1. MDS Microcomputer

a) The initial configuration of the system consisted of a single plasma display interfaced with the MDS microcomputer, and a software package implemented to drive the plasma device to display graphics and alphanumerics. This Hardware and Software interface was done by Babin and Seaman, in NPS thesis "A Microcomputer Based Plasma Display System" in March 1978 [Ref. 26].

Taking the existing configuration and its capabilities, a Software package was initiated to support the graphical requirements of the Shipboard Tactical-situation dipslay system.

Parallel to this effort, a Hardware interface of a second plasma display was initiated by expanding the I/O

capability of the MDS Microcomputer compatible with the first plasma device already installed. Upon completion of the Hardware interface of the second plasma device to the MDS Microcomputer, a second Software interface was implemented to drive the second plasma display. This was done to provide the same graphical and alphanumeric capability as the original plasma device. At this point the Software package initiated to support the graphical requirements of the system was concluded and tested. The software package was then expanded by including the necessary functions to support both plasma displays with different functional capabilities in the same Software package.

The system configuration, consisting of the MDS microcomputer, the two plasma devices along with their hardware and software interfaces, and the graphical package for the system were tested on a stand alone basis to evaluate and validate the graphical capabilities for later integration into the system being developed.

b) With this configuration complete, the next step was to implement the Data management scheme in charge of receiving the raw data sent by the PDP-11/50 (over the MDS-PDP interface), placement in memory (Temporary buffers, with known delimiters), and from there relocation into preformatted Data Structures.

These Data Structures are the Data Bases local to the MDS Microcomputer. The Data is extracted, interpreted, formatted and then handled by the graphical display package to present the informational data at the plasma devices.

To test the Data management scheme, the graphical display package, interface line and handlers were integrated into the hardware already implemented. Then a test data-set was transmitted from the PDP over the interface to the MDS microcomputer to be handled by the data management system and presented as graphical information at both plasma devices.

c) At this point of the development, the basic system framework has been implemented and tested. Data has been successfully transmitted from the PDP-11/50 to the MDS, where it was processed, handled and presented as graphical information.

Due to the limited information that could be presented in a graphical display format in a clear, and unambiguous manner, the need for a complete alphanumeric presentation was obvious. Although an alphanumeric display capability was defined in the early design, an extended capability was implemented because of the graphic display limitations. The alphanumeric display software package consists of two alphanumeric tables created and formatted to present statistical contact information describing the operational environment. One of the tables consists of information about all the contacts in the operational environment. The other table consists of information about a specific contact and information about a specific ownship. The alphanumeric display software package was first tested on a stand-alone basis, then integrated into the current

framework of the system. The new configuration was tested and evaluated, for consistency and validation of both types of display formats (graphical display and alphanumeric display).

d) At this stage in the project development, all major hardware and software components had been implemented providing the basic system configuration to receive data, process data, handle data and display graphical and alpha-numerical information.

The system, as configured, did not provide any interactive facility to allow the operator access to a specific piece of information via any display mode. To eliminate this problem a Man-Machine Interface software package, system compatible, was developed and integrated into the system.

Special attention was paid to the speed of response in the operators-System interaction to avoid psychological step down. The following general design principles were taken into account in the design and implementation of the Man-Machine Interface:

- Simple interface with user: Interaction is accomplished by pressing a single key at the CRT keyboard for each command option. This type of interaction makes the display system very easy to use.

- Self-explanatory: Each command option implemented in the display system provides the operator with the appropriate instructions to execute the command. These

instructions are written to the CRT screen to guide the operator through the command.

- Interaction by anticipation: The display system is constantly prompting the operator at the CRT screen. As a result of the prompting, the operator can identify at any time the current status of the display system.

- Speed of response: Immediate response and feedback to the operator are provided in order to minimize operator distraction.

- Provide choice of methods: A mix of display modes, as explained in chapter three, and command options provide the operator with the capability to select the type of display.

A special feature incorporated in the design of the Man-Machine interface was the integration of a light emitting diode Touch-Panel to one of the Plasma devices. The hardware and software implementation of the Touch-Panel allowed the operator the opportunity to interact directly with the graphical display of informational data.

With the inclusion of the Man-Machine-Interface into the System configuration, the Shipboard Tactical-Situation System at the MDS level was fully implemented and extensively tested.

2. PDP-11/50 Minicomputer

The system development at the PDP-11/50 Minicomputer consisted of a software application package that provided the following capabilities:

a) Command and Control of the Shipbaord Tactical-Situation System including the real time system's clock.

b) Generation of test data (surface contact profile) to simulate operational scenario to test and evaluate display system operation.

c) Capability to abstract from raw data the necessary contact parameters to create the information data bases to transmit to the MDS Microcomputer via the MDS-PDP interface.

Upon completion of the Software application package, the Shipboard Tactical-Situation System (including all Hardware and Software components at the PDP-11/50, MDS and data link) was tested and evaluated utilizing the capability of the PDP-11/50 to generate test data.

VIII. CONCLUSIONS AND RECOMMENDATIONS

The minicomputer based interactive display system implemented in this study is a workable design for the

- Access and retrieval of graphical and alphanumerical information on request.
- Control of the flow of information to the different display devices.
- Accomplishment of the level of correctness expected at the operator and systems level.
- Remote processing required for the reception, handling and formatting of data.

The integration of the capabilities of the display system in conjunction with the computer to computer interface allows the emulation of a Shipboard Tactical situation.

The most critical technical aspect of the project was the implementation of the serial computer to computer interface. The design of the interface required an extensive knowledge of both computers input/output capabilities and operating systems. The information data bases at the 16-bit word PDP minicomputer had to be broken down to bit patterns, transmitted to the 8-bit word MDS microcomputer and then from the bit patterns, reconstructed into the MDS information data bases.

The display system was enhanced by including two plasma scopes to the system. The two plasma scopes not only provided

a back-up capability but also provided for the interaction between the plasma scopes. The interaction provided by the plasma touch panel allowed the operator direct access to graphical data presented. This capability greatly increased the operator's ability to evaluate the tactical situation in a real time manner.

The hardcopy feature available in the system was valuable because it provided redundancy which increases the flexibility and reliability of the system. And, also provided hardcopy historical back up in case of system degradation caused by a loss of a display device, i.e., plasma scope, CRT screen.

It is recommended that to improve the system performance, study should be made in the following areas:

- Expand the alphanumeric hardcopy capability to include graphical hardcopy capability. This will provide a more complete and accurate hardcopy historical back-up.
- Consider the replacement of the DATAMEDIA CRT and Keyboard with a plasma scope. This will permit the utilization of a more powerful display device and it will increase the reliability by eliminating the only cathode-ray-tube device in the system.
- The installation of touch panel devices at all plasma scopes. This will be specially important in the plasma scope used for the interaction with the operator. This is because it will substantially

eliminate the need for a keyboard by replacing the keyboard with software driven "menus" presented at the screen.

- Consider the replacement of the MDS 8-bit machine by a 16-bit microcomputer. This will increase the speed of execution. With this change, the speed of transmission of data should increase, which is highly desireable.

APPENDIX A

OPERATORS MANUAL

FOR THE

DISPLAY SYSTEM

This operator's manual describes the Man-Machine interface of the "DISPLAY SYSTEM" at the Naval Postgraduate School Computer Laboratory.

NAME:

DISPLAY GENERAL DATA STATISTICS TO CRT SCREEN.

DESCRIPTION:

This command loads the most recent data set received and time of request into the General data statistics format to be presented at the CRT screen.

FORMAT:

'B' Enter the command state and the following message will appear at the CRT screen:

GENERAL DATA STATISTICS TO SCREEN (Y/N)

The operator has the option to complete the command by inputting a 'Y' or exiting the command state with no action being taken by inputting a 'N'. A 'YES' or a 'NO' will be printed to the CRT screen reflecting the operator's choice.

NAME:

DISPLAY GENERAL DATA STATISTICS TO LINE PRINTER.

DESCRIPTION:

This command loads the most recent data set received and time of request into the General Data statistics format to be printed at the Line Printer.

FORMAT:

'G' Enter command state and the following message will appear at the CRT screen:

GENERAL DATA STATISTICS TO PRINTER (Y/N)

The operator has the option to complete the command by inputting a 'Y' or exiting the command state with no action being taken by inputting a 'N'. A 'YES' or a 'NO' will be printed to the CRT screen reflecting the operator's choice.

NAME:

DISPLAY GENERAL DATA STATISTICS PER DATA RECEPTION

DESCRIPTION:

This command sets a software switch to either load the data set just received at the MDS microcomputer and time of reception into the General Data Statistics format to be presented at the CRT screen immediately after the Data reception, or bypass this option.

FORMAT:

'S' Enter the command state and the following message will appear at the CRT screen:

PRINT GENERAL DATA STATISTICS PER DATA RECEPTION (Y/N)

The operator has the option to set the switch by inputting a 'Y' or to bypass the option by inputting a 'N'.

A 'YES' or a 'NO' will be printed to the MDS CRT screen reflecting the operator's choice.

NAME:

DISPLAY CONTACT STATISTICS TO SCREEN.

DESCRIPTION:

This Command loads the most recent user specified contact data set and time of request into the Contact statistics format to be presented at the CRT screen.

FORMAT:

'L' Enter the command state and the following message will appear at the CRT screen:

CONTACT STATISTICS TO SCREEN (Y/N)

The operator has the option to continue in the command state by inputting a 'Y' or exiting the command state with no action being taken by inputting a 'N'. A 'YES' or a 'NO' will be printed to the screen reflecting the operator's choice.
If the operator continues in the command state the following messages will appear at the CRT screen:

CONTACT STATISTICS TO SCREEN.
ENTER CONTACT ID:F# or H# or U#.

At this point in the command state, the operator may select any contact that is in the current General Data Statistics. The user 'must' select an allowable two digit alphanumeric contact designator to complete the command.

NAME:

CONTACT STATISTICS TO LINE PRINTER.

DESCRIPTION:

This command loads the most recent user specified contact data set and time of request into the contact statistics format to be printed at the Line Printer.

FORMAT:

'P' Enter the command state and the following message will appear at the CRT screen:

CONTACT STATISTICS TO LINE PRINTER (Y/N)

The operator has the option to continue in the command state by inputting a 'Y' or exiting the command state with no action being taken by inputting a 'N'. A 'YES' or a 'NO' will be printed to the screen reflecting the operator's choice.
If the operator continues in the command state the following message will appear in the CRT screen:

CONTACT STATISTICS TO LINE PRINTER.
ENTER CONTACT ID: F# or H# or U#.

At this point in the Command state the operator can select any contact that is in the current General Data statistics. The user 'must' select an allowable two digit alphanumeric contact designator to complete the command.

NAME:

CURRENT TIME AND DATE TO SCREEN.

DESCRIPTION:

This command presents the current Date and Time to the CRT screen.

FORMAT:

'W' Execute command and the current date and time message will appear at the CRT screen in the following format:

TIME: XX:XX:XX DATE XX/XX/XX

- Time is given in hours, minutes and seconds.
- Date is given in Month, day and year.

NAME:

RESET DATE AND TIME.

DESCRIPTION:

This command allows the user to reset the Date and Time.

FORMAT:

'T' Enter the command state and the following message will appear at the CRT screen:

ENTER NEW DATE/TIME (Y/N)

The operator has the option to continue in the command state by inputting a 'Y' or exiting the command state with no action being taken by inputting a 'N'. A 'YES' or 'NO' will be printed to the CRT screen reflecting the operator's choice.

If the operator continues in the command state the following messages will appear at the CRT screen:

INPUT DATE AND TIME.

YEAR:

The operator may enter the 2 digit year. The year entered will be echoed to the right of 'YEAR:', upon acceptance of the year, 'MONTH:' will be appended to the same line as year. This interaction will be the same for 'MONTH:', 'DAY:', 'HOURS:', 'MINUTES:' and 'SECONDS:'.

Example:

YEAR: 79 MONTH; 05 DAY: 31 HOURS: 14 MINUTES: ØØ SECONDS: ØØ

NAME:

DATA RECEPTION VERIFICATION TO SCREEN.

DESCRIPTION:

This command sets a software switch to either acknowledge received state and print the number of bytes transmitted from the PDP-11/50 minicomputer to the MDS microcomputer per data reception to the CRT screen, or bypass this option.

FORMAT:

'R' Enter the command state and the following message will appear at the CRT screen:

VERIFY DATA RECEPTION. (Y/N)

The operator has the option to set the switch by inputting a 'Y' or to bypass the option by inputting a 'N'. A 'YES' or a 'NO' will be printed to the CRT screen reflecting the operator's choice.

Example:

During the reception of data the following message will appear at the CRT screen:

SYSTEM IN RECEIVE STATE:

After the reception of the updated data the following messages will be added to the previous one at the CRT screen:

PDP PROMPTING: END OF RECEPTION.
PDP BUFFER/FILE WRITTEN TO STRUCTURE.
CHARACTER COUNT: XX BYTES TRANSMITTED FROM PDP TO STRUCTURE.

NAME:

SET STATUS OF PLASMA (1 and 2) AND LINE PRINTER

DESCRIPTION:

This command sets software switches to select the primary display device per data reception for the presentation (device dependent) of graphical or statistical data to the plasma displays or the line printer respectively.

The options are as follows:

(0) Line printer only.

- General Data Statistics per data reception to line printer only.

(1) Plasma One.

- Graphic display of General Data Set.

(2) Plasma Two.

- Graphic display of General Data Set.

(3) Plasma ONE and Plasma TWO.

- Plasma ONE is the primary Graphic display device (Provides capability for touch panel command option), with plasma TWO as a back-up.

FORMAT:

'Z' Enter the command state and the following message will appear at the CRT screen:

REASSIGN PLASMA DEVICES (Y/N)

The operator has the option to continue in the command state by inputting a 'Y' or exiting the command state with no action being taken by inputting a 'N'. A 'YES' or a 'NO' will be printed to the CRT screen reflecting the operator's choice.

If the operator continues in the command state the following messages will appear at the CRT screen:

OUTPUT GRAPHIC DISPLAY TO SWITCH (#).

(0) LP ONLY (1) PLASMA ONE (2) PLASMA TWO (3) PLASMA ONE and PLASMA TWO.

INPUT SWITCH NUMBER: 0, 1, 2 OR 3.

At this point in the command the operator must select an allowable single digit switch number to complete the command.

NAME:

COMMAND OPTIONS TO SCREEN

DESCRIPTION:

This command lists the command options at the CRT screen. The Commands listing will remain at the CRT screen during the current and the next data reception.

FORMAT:

'M' Enter command state and the following message will appear at the CRT screen:

LIST COMMAND OPTIONS: (Y/N)

The operator has the option to complete the command by inputting a 'Y' or exiting the command state with no action being taken by inputting a 'N'. A 'YES' or a 'NO' will be printed at the CRT screen reflecting the operator's choice.

NAME:

COMMAND OPTIONS TO THE LINE PRINTER

DESCRIPTION:

This command prints the Command options at the line printer.

FORMAT:

'N' Enter command state and the following message will appear at the CRT screen:

LIST COMMAND OPTIONS TO LINE PRINTER (Y/N)

The operator has the option to complete the command by inputting a 'Y' or exiting the command state with no action being taken by inputting a 'N'. A 'YES' or a 'NO' will be printed at the CRT screen reflecting the operator's choice.

TOUCH PANEL:

The Touch Panel as described in Chapter III has been implemented in the System as a media (when both plasma devices are active) to draw the contacts in any quadrant and their positions relative to the 'ownship' -- a dashed line is also drawn from the contacts to the 'ownship'.

In order to perform this Command Option the operator must touch any quadrant of the grid draw in Plasma One and the result as explained in the previous paragraph will appear in Plasma Two and will remain until the next updated data is received, unless, the operator decides to touch another quadrant and another picture will appear in Plasma Two.

If the operator performs this command option when the display system is in receive state, the system will bypass the option, and after the receive state is finished only the 'ownship' will appear in Plasma Two, at this point the operator is clear to perform the touch panel option again.

APPENDIX B

DATA ELEMENTS DESCRIPTION

This appendix describes the data elements for the alphanumeric display of the "DISPLAY SYSTEM" at the Naval Postgraduate School Computer Laboratory.

DESCRIPTOR:

CONTACT

FORMAT:

AN----------Where A stands for an alphanumeric digit, N stands for a numeric digit.

RANGE:

A.- F, H or U representing friendly, hostile or unknown respectively.

N.- 0,1,...,9.

DESCRIPTION:

These 2 digits represent a specific contact ID, which is a reference name for display purposes.

DESCRIPTOR:

QUADRANT

FORMAT:

NN---------- Represents a quadrant identified in the grid drawn at the primary and secondary plasma screens.

RANGE:

NN 0,1,...,16

DESCRIPTION:

Is a positional reference point for display purposes, and user interaction with the touch panel device.

DESCRIPTOR:

STATUS

FORMAT:

AA--------- Represent 2 alphanumeric characters, indicating if the contact is friendly, hostile or unknown.

RANGE:

- FR Meaning Friendly Contact.
- HO Meaning Hostile Contact.
- UN Meaning Unknown Contact.

DESCRIPTION:

The characters represent the classification of a specific contact.

DESCRIPTOR:

TYPE

FORMAT:

AAA------ Represent 3 alphanumeric digits, indicating the class of the contact.

RANGE:

As required.

DESCRIPTION:

To be implemented in the future, depending on the System's user. This Descriptor is associated with classified information.

DESCRIPTOR:

COURSE

FORMAT:

III------ Indicates Contact direction relative to the absolute North, measured in Degrees (DG.)

RANGE:

000 Degrees to 359 Degrees.

DESCRIPTION:

Defines Contact course at the primary plasma display, and at the alphanumeric display at the CRT screen and the line printer.

DESCRIPTOR:

SPEED

FORMAT:

II---------- Indicates the real velocity at sea of a given contact, measured in Knots (KTS).

RANGE:

00 Knots to 99 Knots.

DESCRIPTION:

Define Contact speed at the primary plasma display, and in the alphanumeric display at the CRT screen and the line printer.

DESCRIPTOR:

BEARING

FORMAT:

IIIP or

IIIS-------- Where III is the numeric value of the bearing and S/P indicates starboard or port respectively.

RANGE:

000 Degrees

000 Degrees to 179 P

000 Degrees to 179 S

180 Degrees

DESCRIPTION:

Defines the angle between the ownship bow and the position of a given contact.

All bearings are relative to 'ownship'.

DESCRIPTOR:

"RANGE"

FORMAT:

IIIIII----- Where IIIIII is the distance between 'ownship' and a given contact, measured in yards (YD).

RANGE:

0 yards to 226,275 yards.

DESCRIPTION:

Indicates the distance between the 'ownship' and any given contact within the limits of the 80 mile square geographic region. The distance is measured in yards.

DESCRIPTOR:

LATITUDE

FORMAT:

II.IS or

II.IN------- Where II.I is the geographic position of any contact in the South Hemisphere or North Hemisphere. Measured in degrees and tenths of degree.

RANGE:

00.0 degrees to 89.9 degrees North

or

00.0 degrees to 89.9 degrees South.

DESCRIPTION:

Is a geographical positional reference for any contact, used in conjunction with longitude to give an exact position in the geographic region.

DESCRIPTOR:

LONGITUDE

FORMAT:

III.IW or

III.IE------ Where III.I is the geographic position of any contact in the West or in the East. Measured in degrees and tenths of degree.

RANGE:

000.0 degrees to 179.9 W

or

000.0 degrees to 179.9 E.

DESCRIPTION:

Is a geographical positional reference for any contact, used in conjunction with latitude to give an exact position in the geographic region.

DESCRIPTOR:

CPA TIME

FORMAT:

HH.MM------- Given in hours (HH)
and minutes (MM)

RANGE:

00.00 to 24.00

DESCRIPTION:

The Closest point of approximation is the time in which any specific contact is going to be at the nearest possible point to the 'ownship' if and only if the ship courses of both are known, and at least two bearings to the contact are taken in a lapse of 3 minutes.

If the CPA time is negative or greater than 24, is automatically set to zero.

DESCRIPTOR:

CPA DISTANCE

FORMAT:

IIIIII------ Where IIIIII is the distance between the
'ownship' and any contact at CPA time.
Measured in yards (YDS).

RANGE:

0 yards to 160,000 yards

DESCRIPTION:

The distance between any given contact and the 'ownship' at CPA TIME is called CPA DISTANCE.

DESCRIPTION:

COLLISION STATUS

FORMAT:

flashing message:

"COLLISION"

RANGE:

non applicable

DESCRIPTION:

When a collision status (course) with a given contact is identified; this status is presented to the operator in the appropriate format (see format).

DESCRIPTOR:

TIME

FORMAT:

HH:MM:SS---- Where HH represents hours,
Where MM represents minutes,
Where SS represents seconds.

RANGE:

Hours. - 00 to 23,

Minutes. - 00 to 59,

Seconds. - 00 to 59.

DESCRIPTION:

The System maintains a real time clock at the MDS end; Time is utilized in all the statistical Displays and also is available on request by the operator.

DESCRIPTOR:

DATE

FORMAT:

MM/DD/YY---- Where MM represents month,
Where DD represents day,
Where YY represents year.

RANGE:

MM. - 1 to 12,

DD. - 1 to 31,

YY. - 00 to 99.

DESCRIPTION:

The System accepts the date as an input, and increments the day accordingly through the current month, requiring resetting at the beginning of each month. The date is available on request by the operator.

APPENDIX C

MDS-PDP INTERFACE

DETAILED DESCRIPTION

A. DATA/LINK CABLE-CONNECTOR DESCRIPTION

The data link used was an asynchronous serial/ communication line based on EIA standard RS-232-C specifications [Ref. 35].

The data line was connected to the PDP-11/50 distribution bus on the DZ-11 I/O card via a DB25S socket.

The data line was connected to the MDS CRT I/O port via a DB25P connector/plug.

The respective pin connections for the data line socket and connector/plug are given in Figure 23.

B. MDS HARDWARE MODIFICATIONS

The Standard Configuration was modified as follows in order to establish the communication/data link between the Intellec Microcomputer development system (MDS) and the PDP-11/50.

MDS modifications:

The asynchronous serial data/communication link, based on an EIA standard RS-232-C line, was connected to the CRT input/output port. The local MDS CRT device had to be configured to operate connected to the TTY input/ output port with a current loop 20 ma. line. The

DATA LINK PIN CONNECTIONS

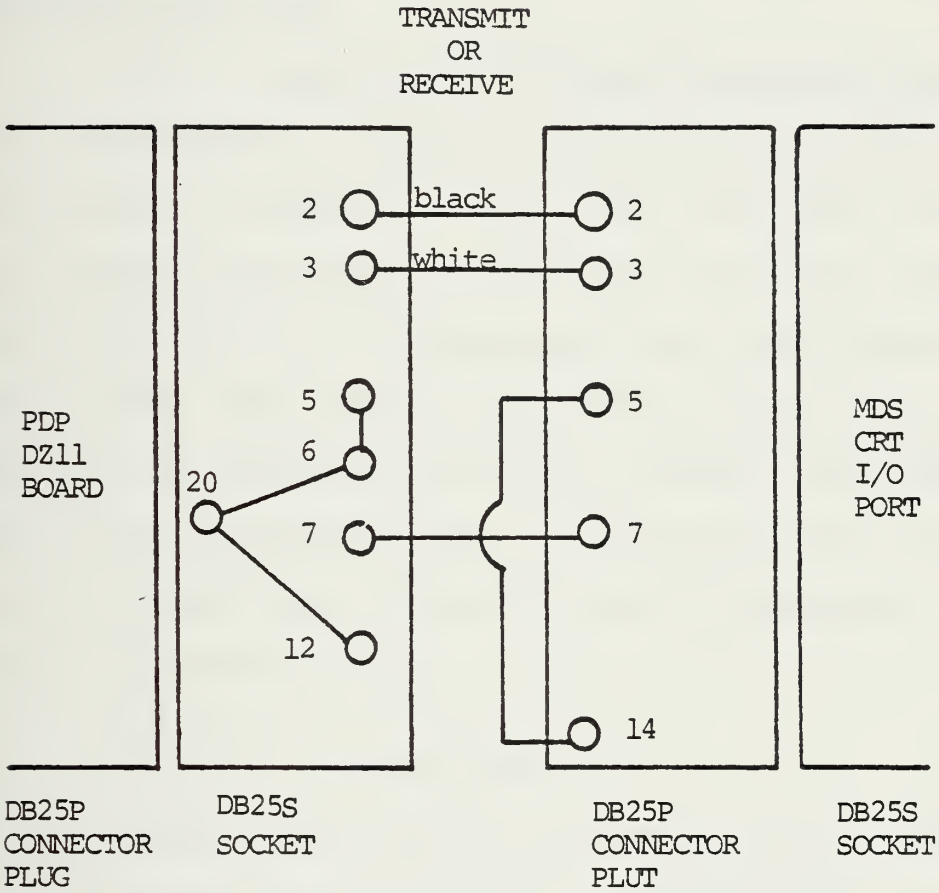


FIGURE 23

"bootstrapping" action was accomplished at this CRT device.

The baud rate for the CRT input/output port usart was set at 2400 baud by connecting jumpers 19-20 in baud rate jumper pad network to allow data transmission to and from the PDP-11/50.

Due to the length of the MDS Interface program, the MDS was incapable of receiving the correct information at 9600 baud. It should be noted that concurrent with setting the CRT usart baud rate to 2400, the TTY usart baud rate was set at 9600. It is imperative that the MDS CRT device and the TTY input/output usart are baud rate compatible. This was accomplished by setting (hardware switches) the CRT device to 9600 baud rate, and/or by setting the CRT device to 2400 baud rate and software programming the TTY usart to 2400 baud rate.

C. PDP SOFTWARE MODIFICATIONS

The asynchronous serial data/communication link, based on EIA standard RS-232-C line, was connected to the distribution bus of the DZ-11 I/O card (8-channel RS-232 I/O).

In order that the PDP-11/50 I/O be compatible with the MDS System I/O parameters, the following parameters were set in system software in the Unix operating system at the PDP 11/50 via the NGETTY.C program module. The NGETTY.C program module of the Unix operating system has the responsibility for setting line parameters for all PDP-11/50 I/O ports, i.e., baud rate, parity, etc.

```
#define HUPCL 01
#define XTABS   02
#define LCASE   04          //  convert upper-case to lower
#define ECHO    010         //  turn on echo
#define CRMOD   020
#define RAW     040
#define ODDP    0100
#define EVENP   0200        //  set even parity
#define ANYP    0300        //  set any parity
#define LEDIT   01          //  set for line edit
#define NOERASE 01000       //  no BS or ERASE capability
                            //  (TTY, for instance)
/*
 * Delay algorithms
 #/
#define CR1 010000
#define CR2 020000
#define CR3 030000
#define NL1 000400
#define NL2 001000
#define NL3 001400
#define TAB1    0020000
#define TAB2    0040000
#define TAB3    0060000

/*
 * speeds
 */
#define B110    3
#define B150    5
#define B300    7
#define B1200   9
#define B2400   11
#define B9600   13

#define SIGINT  2
#define SIGQTT  3

         TABLE CONSTRUCT FOR MDS COMMUNICATIONS WITH THE
         PDP-11/50 at 2400 BAUD (NGETTY.C)
    /* table '6' -- 2400 */
        '6', '6',
        ANYP+RAW+NL1+CR1, ANYP+XTABS+ECHO+CRMOD+FF1,
        B2400, B2400,   LEDIT+NOERASE,
        " n f 007login: ",
```

D. MDS INTERRUPT SYSTEM

The actual implementation of the interrupt system in the MDS Microcomputer involves the use of the PL/M-80 high level language constructs (i.e., interrupt "typed" procedure), the interrupt processing available in the PL/M-80 compiler resident in the ISIS-II operating system, and the interrupt logic (I/O device based interrupts) available on the MDS Hardware through the Monitor [Refs. 20,21,22,23,24, and 25].

The Monitor Interrupt logic groups the seven interrupt lines from the I/O devices; TTY, CRT, Paper tape reader, punch, and line printer interfaces into a status word that can be read, under program control, by the CPU. In addition, the interrupt logic, will, if enabled, issue an interrupt request on level 3 (levels 0,1,2,3,4,5,6,7 available) under the ISIS-II operating system when any one of the interface interrupt lines goes true.

The Monitor interrupt logic consists of six 8097 bus drivers, one 8093 bus driver, one 747D-type flip-flop, and assorted gating circuits as shown on sheet three of the module schematic, Figure 5-18 in Reference 24.

The design at the MDS system level required that the MDS recognize the occurrence of an interrupt from the PDP-11/50 uniquely at the Monitor Interrupt logic. This was accomplished by modifying the A-52 eight to one NAND gate (7430 IC) logic module to a single stage inverter.

This permitted only the recognition of an interrupt (from the PDP-11/50) at the CRT USART.

This capability permitted the MDS to be interrupt driven by the PDP-11/50, by recognizing the interrupt of the PDP, which is in charge of sending the updating data through the interface program.

E. PDP-11/50 INTERRUPT SYSTEM

The interrupt system implemented in the PDP-11/50 minicomputer is based on the recognition of the occurrence of a time interval (generated by the real time system's clock) and an interrupt structure built upon this timing. The interrupt system initiates an interrupt signal to the MDS system, coordinates and executes system to system handshaking to transmit file(s) to the MDS data bases.

APPENDIX D

SOFTWARE FUNCTIONAL DESSCRIPTION

A. MDS "PL/M-80" MODULES

A functional description of each one of the modules used is presented in this section. The subroutines contained in each module are also listed.

NOTE: A subroutine may appear in more than one module.

For a definition of "module" see reference 25.

This is the main program module, that initializes system parameters and interrupt mechanisms to maintain a system ready state. The system ready state enables data reception, data storage, data manipulation, and user interaction via the Command Options and Touch Panel.

This module is responsible for accessing the appropriate software module in order to provide graphical and statistical data display.

MODULE SUBROUTINES:

```
OUTPUT $ STATUS $ LP
SEND $ CHAR $ LP
PCRLF
SEND $ STRING $ LP
INITIALIZE $ SCREEN
INITIALIZE $ PRINTER
CLOSE $ PRINTER
LIST $ MENU $ COMMANDS
LIST $ MENU $ COMMANDS $ LP
ORIG $ STRUCTURE $ WRITE
NEW $ STRUCTURE $ WRITE
ORIG $ PDP $ WRITE
MAKE $ ADDRESS
LOCATE $ STRUCTURE $ PDP
INT $ CHECK
INT $ 3
INT $ 6
```

MAIN PROGRAM SOURCE CODE.

This module provides for the operator initiation of time and date, maintains the correct time through the utilization of the MDS real time clock in interrupt one, provides the capability of loading the current time and date in the appropriate data structure.

MODULE SUBROUTINES:

```
INITIALIZE $ MO $ ARRAY
CLOCK
LOAD $ TIME
ERASE $ LINE
CHECK $ YES $ NO
CHECK $ INPUT
BACK $ SPACE $ ERASE
INITIATE $ TIME
```

This Module declares ISIS-II operating procedures utilized in the manipulation of system files.

PROCEDURE CALLS:

OPEN

CLOSE

READ

WRITE

EXIT

CONSOL

DELETE

ERROR

RENAME

This Module enables and disables specific TTY baud rates, establishes split screen capability, and performs the function of a 'driver' for the input and output of characters and strings to and from the CRT.

MODULE SUBROUTINES:

SET $ TTY $ 9600

SET $ TTY $ 2400

OFF $ CRT $ KEYBOARD

ON $ CRT $ KEYBOARD

OUTPUT $ STATUS $ CRT

SEND $ CHAR $ CRT

CRLF

SEND $ STRING $ CRT

PRINT $ TO $ CRT

INPUT $ STATUS $ PDP

READ $ CHAR $ PDP

INPUT $ STATUS $ CRT

READ $ CHAR $ CRT

SET $ LOW $ HOME

CLEAR $ LOW $ SCREEN

CLEAR $ NEXT $ LINES

GET $ BYTE

CLOCK $ TIMER

This Module defines the appropriate formats in order to display the General Data Statistics table and the Specific Contact Statistics to the upper part of the CRT screen.

MODULE SUBROUTINES:

WRITE $ BIG $ PICTURE

WRITE $ LITTLE $ PICTURE

CONVERT $ ADDRESS $ TO $ CHARS

CONVERT $ BYTE $ TO $ CHARS

LOAD $ DATA $ BIG $ PICTURE

LOAD $ DATA $ LITTLE $ PICTURE

LOAD $ LINE $ ARRAY

BLANK

LOAD $ BLANKS

INITIALIZE $ LOAD $ PICTURE

SET $ STRUCTURE $ ZEROES

This Module writes the General Data Statistics and the Specific Contact Statistics to the line printer.

MODULE SUBROUTINES:

OUTPUT $ STATUS $ LP

SEND $ CHAR $ LP

LPCRLF

WRITE $ BIG $ PICTURE $ LP

WRITE $ LITTLE $ PICTURE $ LP

This Module declares the externals procedures previously declared in SCREEN.MOD and WRITE.LP to be included in MODULES requiring access to these procedures.

MODULE SUBROUTINES:

```
CONVERT $ ADDRESS $ TO $ CHARS
CONVERT $ BYTE $ TO $ CHARS
WRITE $ BIG PICTURE $ LP
WRITE $ BIG PICTURE
WRITE $ LITTLE PICTURE $ LP
WRITE $ LITTLE PICTURE
LOAD $ DATA $ LITTLE PICTURE
INITIALIZE $ LITTLE PICTURE
SET $ STRUCTURE $ ZEROES
```

This Module clears and initializes both plasma screens, erases the grids and numbers the quadrants. It has the capability to draw solid and dashed contact symbols in plasma device one, and solid contact symbols in plasma device two. It also interprets the speed and course of the contacts in order to draw the appropriate tail. Maintains the 5 most recent data sets as back-up and is responsible for labeling (number ID) the contact symbols.

MODULE SUBROUTINES:

INITIALIZE $ GRAPHICS

SEND $ GRID $ PLASMA

SEND $ GRID $ PLASMA $ 2

INITIALIZE $ STRUCTURE

DRAW $ SHIP $ DASH

DRAW $ SHIP $ DASH $ LOOP

STRUCTURE $ BACK

BACKUPS

DRAW $ SHIP $ PROCEDURE

This Module contains the same type of procedures as in GRAPH1-MOD, but they are directed to draw contact symbols in plasma device two.

MODULE SUBROUTINES:

DRAW $ SHIP $ DASH $ 2

DRAW $ SHIP $ DASH $ LOOP $ 2

DRAW $ SHIP $ 2

This Module services the interrupt 6 produced by the touch panel device installed at plasma device one. After the interrupt is produced by touching the panel, a quadrant number is returned, which identifies which contact symbols (solid) are to be drawn at plasma device two. The ownship ship is also drawn at plasma device two and a dashed vector is drawn from every contact to the 'ownship'.

MODULE SUBROUTINES:

SERVICE $ SIX

QUAD $ NUM

This Module contains the External declarations for the Public procedures declared in GARPH1.MOD, GRAPH2.SRC and SERVE.SIX.

MODULE SUBROUTINES:

```
QUAD $ NUM
INITIALIZE $ GRAPHICS
INITIALIZE $ STRUCTURE
SEND $ GRID $ PLASMA
SEND $ GRID $ PLASMA $ 2
DRAW $ SHIP $ DASH
DRAW $ SHIP $ DASH $ LOOP
STRUCTURE $ BACK
BACKUPS
DRAW $ SHIPS
SERVICE $ SIX
DRAW $ SHIP $ DASH $ 2
DRAW $ SHIP $ DASH $ LOOP $ 2
DRAW $ SHIP $ 2
```

This Module is responsible for the interrupt driven communications/interface between the MDS microcomputer and the PDP-11/50 minicomputer, when given control by the main module.

Coordinates 'handshaking', maintains temporary files and buffers to establish the Data link necessary to enable reception of the incoming Data Set produced by the PDP-11/50.

This Module consists of two submodules; MP.DEC which contains the declarations for PDP.MOD, and MP.COD which contains the main body of PDP.MOD.

1. MP.DEC

```
SYSTEM CALLS
OUTPUT $ STATUS $ CRT
SET $ TTY $ 2400
OUTPUT $ STATUS $ PDP
INPUT $ STATUS $ CRT
INPUT $ CHAR $ CRT
SEND $ CHAR $ PDP
CRLF
SEND $ STRING $ CRT
PRINT $ TO $ CRT
READ $ CHAR $ CRT
READ $ CHAR $ PDP
GET $ CHAR $ CRT $ BUF
```

```
GET $ CHAR $ PDP $ BUF
PUT $ CHAR $ CRT $ BUF
PUT $ CHAR $ PDP $ BUF
CRT $ BUF $ FULL
PDP $ BUF $ FULL
PRINT $ HEX $ NUMBER
FORMAT $ HEX
PRINT $ CHAR $ COUNT
INT $ CHAR $ COUNT
COUNT $ CHAR
INT $ NEUTRAL $ STATE
INT $ RECEIVE $ STATE
INT $ TRANSMIT $ STATE
BREAK $ STATE
END $ R
END $ T
WRITE $ RECORD $ TO $ DISK
WRITE $ PDP $ BUFFER
REBOTT
```

2. MP.COD

MAIN BODY OF PDP.MOD

This Module contains the System Level Plasma primitives which call the hardware plasma primitives utilized to create Display formats, grid patterns, and Symbolic representation of data. This Module consists of the union of six other Modules:

PLAEXT . ONE

PLAEXT . TWO

PLAPUB . ONE

UNKNOW . SR1

PLAPUB . TWO

UNKNOWN . SR 2

This Module contains the System Procedures to:

- create and label grids
- create Friendly and Hostile solid and dashed symbols
- create ID number for each contact
- provide the erase capability for Friendly and Hostile symbols

for Plasma Device one.

MODULE SUBROUTINES:

```
WRITE $ CONTACT $ ID
DRAW $ GRID
DRAW $ FRIEND $ SYMBOL
DRAW $ FRIEND $ DASH
ERASE $ FRIEND $ DASH
ERASE $ FRIEND $ SYMBOL
DRAW $ HOSTILE $ SYMBOL
DRAW $ HOSTILE $ DASH
ERASE $ HOSTILE $ SYMBOL
ERASE $ HOSTILE $ DASH
```

This Module draws unknown solid and dashed contact symbols at Plasma device one.

MODULE SUBROUTINES:

DRAW $ UNKNOWN $ SYMBOL

ERASE $ UNKNOWN $ SYMBOL

DRAW $ UNKNOWN $ DASH

ERASE $ UNKNOWN $ DASH

This Module contains the System Procedures to:

- create and label grid
- create Friendly and Hostile solid and dashed symbols
- create ID number for each contact
- Provide the erase capability for Friendly and Hostile symbols

for Plasma Device Two.

MODULE SUBROUTINES:

WRITE $ CONTACT $ ID $ 2

DRAW $ GRID $ 2

DRAW $ FRIEND $ SYMBOL $ 2

DRAW $ FRIEND $ DASH $ 2

ERASE $ FRIEND $ DASH $ 2

ERASE $ FRIEND $ SYMBOL $ 2

DRAW $ HOSTILE $ SYMBOL $ 2

DRAW $ HOSTILE $ DASH $ 2

ERASE $ HOSTILE $ SYMBOL $ 2

ERASE $ HOSTILE $ DASH $ 2

This Module draws unknown solid and dashed contact symbols at Plasma device two.

MODULE SUBROUTINES:

DRAW $ UNKNOWN $ SYMBOL $ 2

ERASE $ UNKNOWN $ SYMBOL $ 2

DRAW $ UNKNOWN $ DASH $ 2

ERASE $ UNKNOWN $ DASH $ 2

This Module contains the External declarations for the Public Procedures in PSPRIM.MOD, for Plasma primitives for Device one.

MODULE SUBROUTINES:

SET $ STATUS $ PLASMA

PLASMA $ WRITE

CLEAR $ PLASMA

PLASMA $ WRITE $ VECTOR

PLASMA $ PRINT $ STRING

INITIALIZE $ PLASMA

SET $ VECTOR

START $ VECTOR $ SOLID

STOP $ VECTOR $ SOLID

START $ VECTOR $ DASH

STOP $ VECTOR $ DASH

GRAPHIC $ DESIG

START $ ERASE $ VECTOR

STOP $ ERASE $ VECTOR

START $ ERASE $ DASH

STOP $ ERASE $ DASH

This Module contains the External declarations for the Public Procedures in PSPR2.SRC for plasma primitives for Device two.

MODULE SUBROUTINES:

SET $ STATUS $ PLASMA $ 2

PLASMA $ WRITE $ 2

CLEAR $ PLASMA $ 2

PLASMA $ WRITE $ VECTOR $ 2

PLASMA $ PRINT $ STRING $ 2

INITIALIZE $ PLASMA $ 2

SET $ VECTOR $ 2

START $ VECTOR $ SOLID $ 2

STOP $ VECTOR $ SOLID $ 2

START $ VECTOR $ DASH $ 2

STOP $ VECTOR $ DASH $ 2

GRAPIC $ DESIGN $ 2

START $ ERASE $ VECTOR $ 2

STOP $ ERASE $ VECTOR $ 2

START $ ERASE $ DASH $ 2

STOP $ ERASE $ DASH $ 2

This Module contains the external declarations for the public procedures of PLASMA.MOD, specifically the Sub-Modules of PLASMA-MOD.

- PLAPUB.ONE
- PLAPUB.TWO
- UNKNOW.SR1
- UNKNOW.SR2

MODULE SUBROUTINES:

```
WRITE $ CONTACT $ ID
DRAW $ GRID
DRAW $ FRIEND $ SYMBOL
DRAW $ FRIEND $ DASH
ERASE $ FRIEND $ DASH
ERASE $ FRIEND $ SYMBOL
DRAW $ HOSTILE $ SYMBOL
DRAW $ HOSTILE $ DASH
ERASE $ HOSTILE $ SYMBOL
ERASE $ HOSTILE $ DASH
DRAW $ UNKNOWN $ SYMBOL
ERASE $ UNKNOWN $ SYMBOL
DRAW $ UNKNOWN $ DASH
ERASE $ UNKNOWN $ DASH
WRITE $ CONTACT $ ID $ 2
DRAW $ GRID $ 2
```

```
DRAW $ FRIEND $ SYMBOL $ 2
DRAW $ FRIEND $ DASH $ 2
ERASE $ FRIEND $ SYMBOL $ 2
DRAW $ HOSTILE $ SYMBOL $ 2
DRAW $ HOSTILE $ DASH $ 2
ERASE $ FRIEND $ DASH $ 2
ERASE $ HOSTILE $ SYMBOL $ 2
ERASE $ HOSTILE $ DASH $ 2
DRAW $ UNKNOWN $ SYMBOL $ 2
ERASE $ UNKNOWN $ SYMBOL $ 2
DRAW $ UNKNOWN $ DASH $ 2
ERASE $ UNKNOWN $ DASH $ 2
```

This Module contains the Software primitives to handle the interface between the MDS microcomputer and the S.A.I. plasma device one, and the implementation of the following functions in software:

MODULE SUBROUTINES:

SET $ STATUS $ PLASMA

PLASMA $ WRITE

CLEAR $ PLASMA

PLASMA $ WRITE $ VECTOR

PLASMA $ PRINT $ STRING

INITIALIZE $ PLASMA

SET $ VECTOR

SET $ VECTOR $ ONE

START $ VECTOR $ SOLID

STOP $ VECTOR $ SOLID

START $ VECTOR $ DASH

STOP $ VECTOR $ DASH

GRAPHIC $ DESIGN

START $ ERASE $ VECTOR

STOP $ ERASE $ VECTOR

START $ ERASE $ DASH

STOP $ ERASE $ DASH

This Module contains the Software primitives to handle the interface between the MDS microcomputer and the S.A.I. plasma device two, and the implementation of the following functions in software:

MODULE SUBROUTINES:

SET $ STATUS $ PLASMA $ 2

PLASMA $ WRITE $ 2

CLEAR $ PLASMA $ 2

PLASMA $ WRITE $ VECTOR $ 2

PLASMA $ PRINT $ STRING $ 2

INITIALIZE $ PLASMA $ 2

SET $ VECTOR $ 2

SET $ VECTOR $ ONE $ 2

START $ VECTOR $ SOLID $ 2

STOP $ VECTOR $ SOLID $ 2

START $ VECTOR $ DASH $ 2

STOP $ VECTOR $ DASH $ 2

GRAPHIC $ DESIGN $ 2

START $ ERASE $ VECTOR $ 2

STOP $ ERASE $ VECTOR $ 2

START $ ERASE $ DASH $ 2

STOP $ ERASE $ DASH $ 2

B. PDP "C" PROCEDURES

A functional description of each procedure is presented in this section.

This is the main program procedure that is responsible for the following:

- Initialization of system Parameters
- Creation of the appropriate Data Structures
- Provides the logic for the Interrupt mechanism
- Controls the timing between interrupts and the internal calls of the other Subroutines
- Provides the logic for the creation, manipulation and transmission of the Data to be sent to the MDS-end.

This procedure is responsible for simulating an operational scenario, by generating a coherent data set over time relative to a tactical situation.

This procedure is a "Demo" program which generates the data that in real world will be generated by sensors interfaced with the main frame computer.

This procedure is invoked by the MAIN procedure each time an updated data set is required.

This procedure initializes the data structures to zero.

This initialization to zero of all data structures is necessary to clear the memory locations of the data structures.

This procedure is invoked by the MAIN procedure at the beginning of MAIN prior to the System Control Logic.

This procedure formats all 16-bit word data via bit manipulations prior to interacting with the output buffer. This formatting consists of transforming 16-bit words to two 8-bit words, respecting the bit hierarchy (relative position).

When these two 8 bit words are received by the MDS microcomputer, a 16 bit variable is created in memory by placing the lower and upper 8-bit words at the appropriate memory locations. The manipulation described above is necessary because the PDP-11/50 is a 16-bit machine vice the MDS, which is an 8-bit machine.

EOT

This procedure contains the appropriate data elements to close the transmission state at the PDP, provides delimiters to the data sets, and terminates the receiving state at the MDS-end.

This routine calls the procedures to calculate the data elements to be loaded into the data structures prior to transmission of the updated data set to the MDS-end.

The procedures called and respective functions are as follows:

1. LDLAT:

   Calculates the latitude of a specific contact and loads the value to the data structure.

2. LDLONG:

   Calculates the longitude of a specific contact and loads the value to the data structure.

3. LDCOUR:

   Calculates the course of a specific Contact and loads the value to the data structure.

4. QUANDNUM:

   Calculates the quadrant number (of the grid pattern) of a specific contact and loads the value to the data structure.

5. LDRANG:

   Calculates the distance between any contact and the designated "ownship."

6. LDBEAR:

   Calculates the bearing between any contact and the designated "ownship."

7. LDCPATD:

Calculates the CPA-TIME and CPA-DISTANCE between any contact and the designated "ownship."

APPENDIX E

DESCRIPTION OF GRAPHIC DISPLAY TECHNOLOGY

A. GENERAL INFORMATION

Most graphic display systems use refresh or storage technology. Three main types of refresh technologies exist: stroke writing, raster scanning and scan converting. Stroke writing display systems position an electron beam on the tube face much as one would draw on paper with a pencil. In raster scanning systems, the beam sequentially traces the entire face of the tube. When the beam arrives at a point that belongs to the picture under construction, a video signal brightens the beam to illuminate the screen. Hybrid scan converters use a storage tube to store the image and then scan the storage tube information onto a raster scanning monitor to display the image. Since the persistance of the phosphor in the tube is low, CRT's using one of these technologies require periodic image refreshing to prevent annoying screen flicker. These CRT's refresh the image at least forty times each second.

Two storage technologies exist: the storage tube and the plasma panel. With the storage tube, the CRT receives its image in the same way as a stroke writing system. However, the storage tube stores the image on a grid, eliminating periodic refresh. Unlike other graphic display systems, plasma panels do not use CRT's. The display consists of a

series of bright data that can be formatted into alpha-numerics and graphics. Plasma panels do not require refresh and, once a particular print on the display is "turned on," it continues to glow until "turned off."

B. PLASMA PANEL PHYSICAL DESCRIPTION

1. PANEL PARAMETERS

a.	Actual area;	8.55" x 8.55"
b.	Panel Glass size:	12.25" x 12.25"
c.	Light Spot Size:	10 to 12 mils
d.	Addressable Matrix:	512 x 512
e.	Dot spacing	0.0167" center-to-center 60 per inch
f.	Brightness:	50-foot Lamberts
g.	Contract ratio:	25 to 1 (nominal)
h.	Color:	Neon-range (585.2 manometers)

2. CHARACTER SIZE (other sizes dependent upon driving logic and/or software)

a.	5 x 7 matrix	80 x 120 mils
b.	7 x 9 matrix	120 x 150 mils

3. ELECTRIC DESCRIPTIONS

The Plasmascope primary power requirements are:

a. 115 v ac

b. 47 to 440 HZ

c. 300 watts maximum

d. single phase

4. PERFORMANCE

a. Data Rates: addressable to the individual dot data at 50 KHZ;

b. Parallel Mode: 330 msecs to address the entire screen. The parallel mode of operation allows the simultaneous addressing of 16 points in the Y axis. Y_o, Y_8 and Y_4 through Y_7 (Y_o, Y_8) of the Y address are used to select one of 32 sectors, each of which comprises 16 consecutive horizontal electrodes. The X address selects one column of 16 points in the addressed sector. The parallel address inputs are then used to address any number of the 16 points in the selected sector column.

5. DATA CODE

ASCII character set for alphanumberic operation (7 bit).

6. CHARACTER MATRIX

5 x 7 or 7 x 9 dot matrices.

7. RELIABILITY

The mean-time-between failure (MTBF) for the plasmascope is over 6,000 hours with JAN-TX parts at 25°C.

8. MAINTAINABILITY

The mean-time-to-repair (MTTR) for the plasmascope is 2 hours, board level maintenance or on-board replacement.

9. ELECTROMAGNETIC INTERFERENCE/TEMPEST

The plasmascope has been tested to MIL-STD-461 for EMI suppression. Several aspects of the model 2500 design are more critical for Tempest than for EMC. These include the display panel, the keyboard, and the power line. The display panel contains grid wires, approximately 8 inches

long, that contain signals which correlate with the information being displayed. A periphery conded metallic film on a face plate is provided for the display panel to minimize radiation. This precaution has been sufficient to permit other displays of similar design to meet the Tempest requirements.

The keyboard is somewhat exposed to radiation as discussed above for EMC. Because the exciting signal levels are small (HALL Effect voltages) and because the radiating elements are electrically very short at the processing signal frequencies, the keyboard is expected to satisfy Tempest requirements.

The power level conductor requirements of Tempest are met by a combination of filtering and consideration of Tempest requirements in the design of the power supply.

The display electronics operates at 50 KHZ, a frequency at which the EMI filters provide attenuation. The data lines between the Model 2500 and any data source can be designed for Tempest by providing adequate cable shielding to control EM radiation.

APPENDIX F

INTERRUPT STRUCTURES

A. BACKGROUND INFORMATION

A very large percentage of microprocessor systems are employed in control applications, i.e., situations in which the CPU controls a process in the "real" world by analyzing information concerning the behavior of the process.

Information is a measure of "surprise," and in many systems this equates as much to "when" as to "how much." To find out "when" an event occurs, it is possible to input and test status bits that are set by its occurrence. For a number of systems this may require almost continuous sampling while only a relatively few samples return much information. The machine can do no useful work while sampling and, thus, is inefficiently utilized. By allowing the events of interest to signal for the machines' "attention," the efficiency can be vastly improved. Thus, interrupt structures allow "event-driven" systems in which the concept of temporal continuity has little relevance.

Interrupts signifies either the occurrence of an internal operating system event such as the completion of a process or the status of the Real Time Systems clock, or, the readiness of a peripheral device such as a Teletype or a CRT to communicate data to or from the computer. The ability to respond to "external" events relative to the execution of the

current process allows processors to be shared by one or more processes if a means can be found to handle "simultaneous" events, i.e., those events occurring within one basic system cycle -- normally the current instruction cycle. The usual means of handling simultaneous "interrupt requests" is by embedding the "concurrent" processes within a priority structure. The priority structure can be implemented in hardware and/or software.

The functioning of an interruptable computer program can be viewed as similar to that of the job of a secretary. The secretary has a scheme of priorities about her work, higher priority items being serviced on a more immediate schedule than lower priority items. Imagine the situation of a letter being typed when the phone rings. The activity in progress, the letter, is suspended while the immediate demand of the telephone is serviced. When the phone call has been disposed of the former, lower priority, typing activity is resumed. Some items have ultimate priority in this scheme, a fire alarm for example. No sane person bothers to answer the phone or even less to continue typing a letter when the building is burning down. Another important feature of the secretary's work environment is that nothing is of such priority that it must be done instantaneously. If the phone rings in the middle of a typed word or while the typist is taking a sip of coffee, the work is finished or the cup set down on the desk before picking up the phone. This illustrates an important feature of interruptable environments.

However the interruption is serviced, it must not cause a disruption of the former activity in such a way that it cannot be successfully resumed.

When a program is interrupted, the presumption is that the cause of the interruption is of some immediate priority, but not of such priority that the lower prioirty task being interrupted needs to be disrupted. One thing therefore needs to be understood at the outset about interrupts. The instruction in progress when the interrupt request arrives is always finished before the interrupt is honored. It does not require much imagination to see what would happen if an addition or jump could be interferred with before being completed. When the lower priority activity was resumed after servicing the interrupt the program would have no means of rectifying the damage done by the half-completed addition or jump.

The most important single thing that the programmer must remember about interrupted programs is that the status of the interrupted program must be preserved. The program which services the high priority interrupting activity will use the same registers and flags to accomplish its task as the interrupted program uses. These registers and flags must be restored to their condition at the time of the interrupt before returning control to the former activity, or the former activity will be disrupted. Failing to observe this caution is the most common single error in programming for interrupt

driven systems. The saving and restoring of the status of the interrupted program is of crucial importance.

A very common type of interrupt is that caused by some event external to the program which does not require that data be transmitted. The event itself constitutes the required information. In this category are such applications as traffic counters. The passage of a car through the sensor of an expresway ramp does not require the transmission of data for that car to be counted in the flow. In this case the interrupt itself constitutes notice to the system that a car has passed the sensor and that the counter is to be incremented. A similar situation is encountered in devices that register angular position through the counting of passing gear teeth. Exactly which tooth has passed is not of any interest, only the fact that a tooth has passed is of consequence.

Perhaps the most common of these event counting situations occurs with the computer option called a real time clock. The real-time clock is not a clock in the common sense of that word. It does not keep time at all, but simple generates a series of pulses at uniform intervals, these pulses being used to cause interruption of the operating program at these uniform intervals. The program which counts the interrupts can use this counting to keep a programmed time-of-day clock.

The elementary process that is crucial to an interrupt structure is the CALL/RETURN transfer-of-control process.

The subroutine is a sequence of code that is executed upon the invocation of its name and that returns control to the calling sequence upon completing its execution. An interrupt process can be thought of as an unexpected or surprise subroutine call. In a program, the invocation is accomplished by inserting a call instruction at a known position in the instruction sequence. During interrupt processes, the invocation will occur at unknown positions in the control sequence. Thus, provision must be made for saving the return address in a known location for later retrieval. Mathematics can be described as a "replacement" process in which the replacements are made under control of the mathematician. Interrupt systems are those in which the replacement of a given control sequence by another can be made upon request from any external system. The complete control sequence is composed of a set of elementary sequences, or control strings, that can be edited by real-world systems to adapt to local conditions.

Varieties of interrupt structures are designed with one goal in mind: to share one CPU efficiently between several "concurrent" processes. This can be accomplished via this procedure:

- save state of current process;
- identify device requesting service;
- transfer control of CPU to this device;
- upon completion of service, restore state; and
- transfer control of CPU back to interrupted process.

Although minor variations exist in implementation of these steps, they are always executed. This procedure is shown diagrammatically in figure 24.

B. PRIORITY INTERRUPTS

There are two basic implementation strategies for priority interrupts: Polled priority interrupts and Vectored priority interrupts.

1. POLLED PRIORITY INTERRUPTS

Polled priority interrupt methods trap (acknowledge and jump) all interrupts requests to a common location, and a routine that POLLs status bits determines the source of the interrupt request. If the interrupting devices can be arranged in a hierarchical order, then the highest priority device will be polled first, the next highest will be polled second, and so on. Thus, if two devices request service at once, the higher priority will be encountered first in the poll and it will receive service first. It should be noted that this method does not involve clearing the interrupt request.

2. VECTORED PRIORITY INTERRUPTS

An interrupt system in which the hardware supplies a separate address for each interrupting device is called a VECTORed interrupt structure as opposed to the POLLed structure in which all devices trap to the same address, and device identification and conflict resolution are accomplished in software.

INTERRUPT PROCESS SCHEME

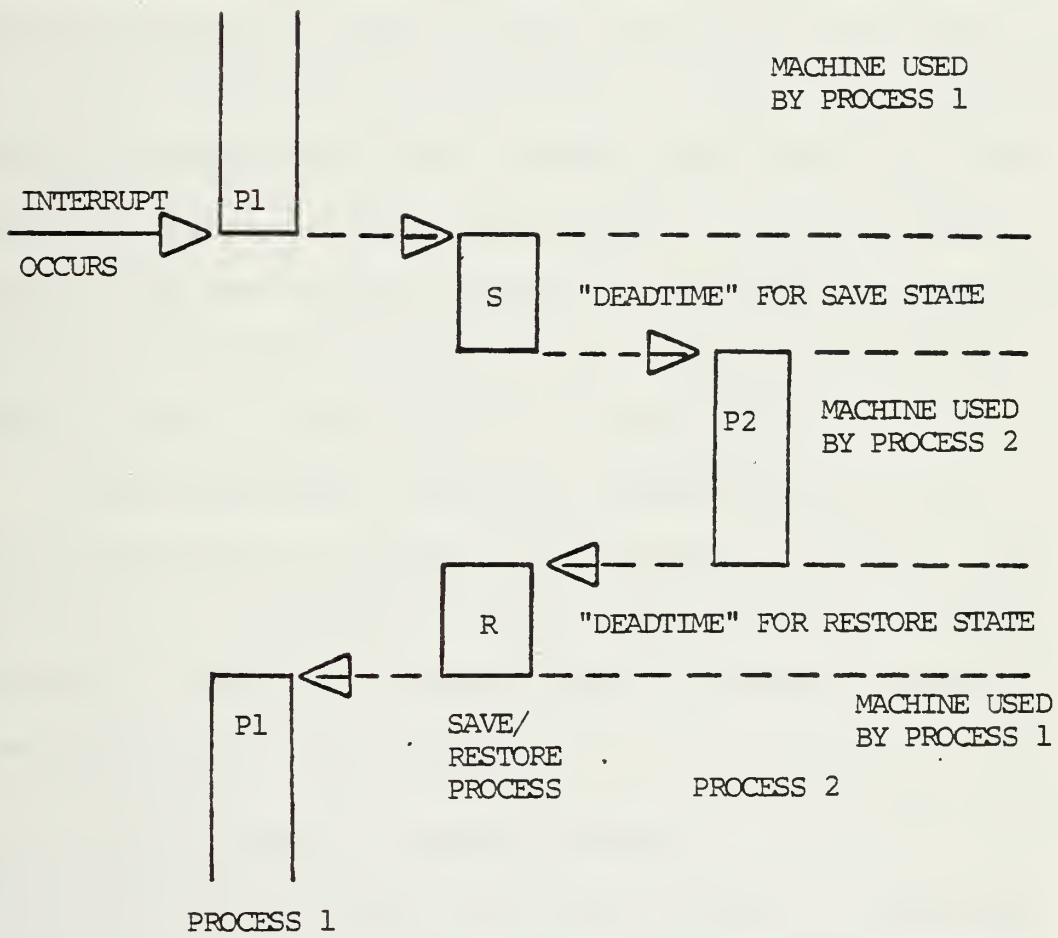


FIGURE 24

The use of hardware to encode these instructions for separate devices will speed up interrupt servicing by eliminating the need to POLL the devices. In addition, standard hardware is available for conflict resolution.

If two devices simultaneously request service, a priority encoder will pass only the higher priority request. This feature by which higher priority devices can interrupt lower priority devices, but lower priority devices cannot interrupt higher, is common to most interrupt structures.

Each device can have a unique address associated with its service routine, and the hardware just described automatically provides a 1-byte call instruction that causes transfer of control to this address. VECTORed interrupt systems provide the fastest possible interrupt servicing, because no time is wasted polling status bits.

Since the highest priority requests override all others there must be a means of individually removing each request as it is serviced, so that lower priority requests can be seen. The lower requests must, therefore, remain active until their time comes.

C. 8080 MICROPROCESSOR INTERRUPT METHOD

The 8080 microprocessor interrupt method is described below to illustrate a VECTORED PRIORITY INTERRUPT STRUCTURE implemented in a microcomputer.

An interrupt can occur when all of the following three conditions are met. If any of them is not met the interrupt cannot occur. They are:

1. The 8080's interrupt system has been enabled by the use of EI (Enable Interrupts) instruction. The term enable has specific application to the interrupt system as a whole and is not applicable to any specific device or peripheral. The interrupt system is enabled by the EI instruction and disabled by the DI (Disable Interrupts) instruction. In the disabled state no interrupts from any source can occur.

2. The specific device or peripheral interface has been conditioned by the program in such a way as to be able to generate interrupting pulses. This conditioning is known as arming. An interface which has been so conditioned is said to be armed. If the interface has not been conditioned so as to be able to generate interrupting pulses it is said to be disarmed.

3. The device or peripheral ready flag is set by the event which is to cause the interrupt.

Again, in the absence of any of the above conditions there is not and cannot be an interrupt. When the above conditions are all met, the following sequence of events takes place:

a. After finishing the execution of the instruction in progress at the time all of the conditions for interrupt were met, a special instruction is forced into the instruction register (I). This instruction is provided by the hardware itself and is not resident in computer memory. The program counter is not changed by this. It still points to the next program instruction to be executed, i.e., the

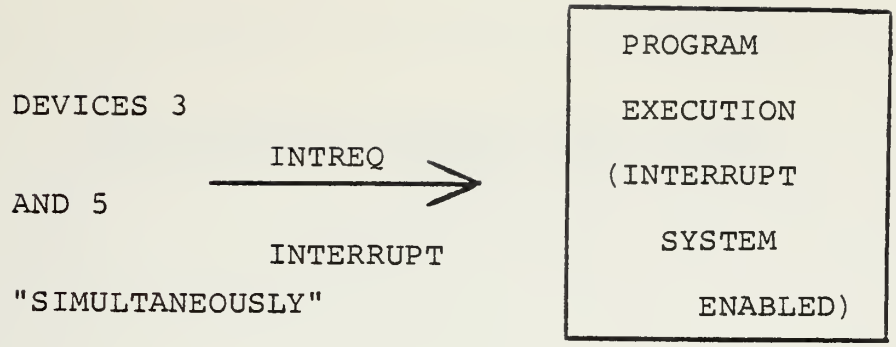
instruction following the one in progress at the time the interrupt conditions are met.

b. The special instruction forced into the instruction register is executed. This special instruction is a kind of CALL, but one in which the effective address is implicit rather than the normal CALL whose target address is explicitly given in the instruction. The special call, known as a restart, pushes the program counter onto the stack just as a normal CALL does. Instruction execution then starts at the address which was implicit in the interrupte instruction.

EXAMPLE: 8080 SOFTWARE INTERRUPT

The following was abstracted from "Microprocessor System Design," by C.E. Klingman [Reference 1]. In the example the Intel 8080 interrupt system is described in detail in order to present the hardware and software concepts associated with such systems. The concepts presented include POLLed versus VECTORed systems, priority determination and conflict resolution, priority thresholds, stacked state vectors, individually CLEARable device flags, and service routines. With minor variations, almost all interrupt systems utilize these concepts.

SCENARIO: During a process (i.e., service routine), I/O devices 3 and 5 interrupt almost simultaneously and then device 2 and then device 7 interrupt.



The lines from device 3 and device 5 clock the appropriate flip-flops, and the "REQUEST ACTIVITY" line becomes active. We assume that the comparator override is active and the binary code "5" from the encoder causes a high input to appear at the Interrupt Request flip-flop D-input. The next system clock pulse causes an interrupt request to be presented to the 8080 CPU. This same signal also latches the "5" into the priority latch and disables the gate following the comparator, thereby preventing further interrupts.

The CPU will finish the current execution and then, at the beginning of the following FETCH cycle, the INTAK status line will go high (and MEMRD will go low), causing the instruction to be fetched from the Interrupt Instruction Port instead of from memory. This port uses the output of the Priority Control Unit to compose a "TRAP 5" instruction that causes the (unincremented) program counter to be saved as a return address on top of the stack in the RAM and loads the program counter with 0...0101000. Thus, the next instruction is fetched from TRAP CELL 5 (location 40) in memory (see figure 25). This location contains a JUMP to FIVE-SERVICE, which is the routine as we now develop.

8080 EXAMPLE INTERRUPT FLOW DIAGRAM

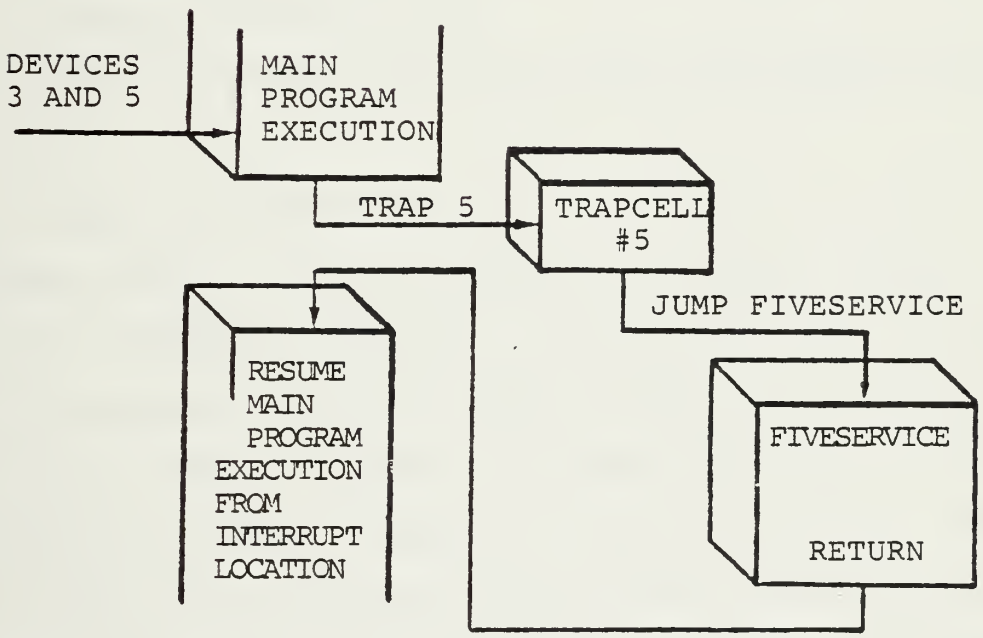


FIGURE 25

The service routine for device 5 performs the following tasks.

1. Push PSW, B,D,H (registers) onto the stack. The CPU state vector is saved for later return to the interrupted program execution.
2. Save the current status "IMAGE" by pushing it onto the stack.
3. Update the "IMAGE" in memroy.
4. Load the current status latch with 5, thereby enabling the 8214 Priority Control Unit, and clearing device 5 flag.
5. Enable the 8080 Interrupt system via execution of EI.
6. Begin servicing device 5.

Assume that at this point device 2 issues a request. Since the threshold is set at 5, this request will not generate an interrupt but will remain present as the device 2 flag. The 5 service routine continues executing. During its execution, device 7 issues an interrupt request. This code is above the threshold, and the 8214 PICU generates an interrupt to the 8080 CPU, latches #7 into AAA, and disables itself until enabled by the 8080. The hardware causes a TRAP 7 instruction to be composed and jammed into the CPU.

The location of the next instruction to be executed in FIVE-SERVICE is stored on the stack, and TRAP CELL 7 is entered. TRAP CELL 7 contains a JUMP SEVEN-SERVICE instruction, and control transfers to this routine. The 8080 state

vector (accumulator, flags, and register file) is pushed onto the stack, and the current "IMAGE" is also stored there. The Current Status Latch is updated, and the "IMAGE" is updated in memory. The device 7 flag is cleared when the current status is updated and the 8214 is re-enabled. The 8080 is re-enabled via an EI instruction, and device 7 is serviced. Upon completion of the device service, the 8080 is disabled via the DI instruction, and the "LAST STATUS" is POPped into the accumulator and restored to the current status latch, resettting the threshold to 5. Device 6 is assumed inactive; therefore, no INTREQ is generated by the 8214. The 8080 state vector is restored from the stack, the 8080 interrupt system is enabled, and a RETURN instruction is executed. (The system is enabled on the second instruction FETCH cycle following EI to prevent wild stack growth in a dense interrupt environment.) The return address stored on the stack is jammed into the program counter, and control returns to the interrupted FIVE-SERVICE routine.

Upon its completion, the CPU interrupt system is again disabled, the state vector restored from the stack, the IMAGE or "LAST STATUS" is POPped and loaded into the current status latch. The initial status was "ALL" (i.e., the comparator override bit was set); therefore, the device 3 flag that is still set causes the PICU to generate an interrupt request and a vector to TRAP CELL 3. The FIVE-SERVICE ends with an EI and a RETURN to the interrupted program. The

enabled 8080 interrupt system responds immediately to the pending request and enters TRAP CELL 3.

From this point, the THREE-SERVICE routine behaves exactly as the FIVE- and SEVEN-SERVICE routines. If no higher devices interrupt, THREE-SERVICE completes, returns to MAIN and finally device 2 flag gains entry to the TWO-SERVICE routine via TRAP CELL 2.

The procedure just described is summarized now for a general device in interrupt process.

1. Store JUMPT O N-SERVICE TO TRAP CELL N.
2. Jam TRAP N instruction into CPU via INTAK.

N-SERVICE:

1. Push CPU state vector onto stack.
2. Get "IMAGE" of status and save as "LAST STATUS" on the stack Update "IMAGE" in memory.
3. Load current status latch with N, clearing device N flag and re-enabling the 8214 Priority Interrupt Control Unit with threshold set to N.
4. Enable the 8080 interrupt system via execution of EI.
5. Service device N.
6. Disable 8080 interrupts (DI).
7. Reset threshold to "LAST STATUS" and update IMAGE in memory.
8. Re-store CPU state vector from stack.
9. Enable 8080 INT system (EI).
10. Return to interrupted location.
11. Honor highest pending interrupt, or proceed with interrupted routine if no interrupts are pending.

APPENDIX G

PLASMASCOPE TOUCH PANEL DESCRIPTION

The device electronics can be divided into three sections: the scanning system, consisting of the oscillator-counter; the light sources and the detectors; and the control logic.

The scanning system eliminates the optical collimation problem usually associated with a light-grid touch panel. The system only activates one light source/detector at a time. Time is the means of separating the light beams rather than a complex optical collimation system. This scanning is controlled by a free running oscillator driving a 4-bit counter. The output of the counter is used to sequentially select the light source/detector pairs, and to provide the address.

The light sources are infrared light emitting diodes (LED) chosen for their high output power, cost, and package design. Since these devices are diodes, a diode matrix drive scheme is used to reduce complexity. The output of the counter activates the appropriate transistors and causes two of the diodes to turn-on; one diode is in the x array, the other in the y array. In this way each diode pair (one x, one y) is sequentially pulsed and the display is scanned.

The detectors are silicon phototransistors similar to the LED in package design. The detectors are located across from the LED's in a plastic frame which fits around the display. Four detectors, spaced evenly along the side, share

a common amplifier. The output of the four amplifiers are time multiplexed so that the proper amplifier is actuated at the correct time. Only four amplifiers are needed because of the natural optical collimation associated with the plastic frame. For example, detectors #0, 4, 8, and 12 are activated when LED #0 is pulsed. Light from #0 LED is received by the #0 detector. The other detectors sharing the amplifier with #0 receive very little light from #0 LED.

The amplifier feeds the signal from the detector to a voltage comparator which can have one of two voltage thresholds. The purpose is to introduce scanning hysteresis into the system. Scanning hysteresis eliminates false inputs due to room light and partially broken beams. It works by setting up two conditions; one for initially detecting if the light beam is broken, and one for subsequently deciding when it is not broken. When initially scanning, the detect level is set low so that a beam to be detected broken must be completely absent. Upon the detection of both an x, y broken beam, the threshold voltage is raised to a higher level. Now a beam to be detected again must be larger than this higher threshold. In this way, marginal signals are ignored and only a beam, either absent or present is detected.

The basic operation of the total system is to sequentially activate pairs of source/detectors on both the x and y axes by means of the scanning logic. When a broken beam is detected, the address (or position) is stored in the appropriate storage register. When both an x and y beam are broken, the

information is sent to the computer. Scanning continues and with each scan, any new broken positions are compared with the old position stored in the registers. If the positions agree (i.e., the obstacle has not moved) scanning continues; if they disagree (the obstacle has been removed or shifted to a new location), the system resets. Touch inputs for the touch panel are limited to 10/sec by a short delay before reactivating. See figure 26 for Block Diagram.

TOUCH PANEL BLOCK DIAGRAM

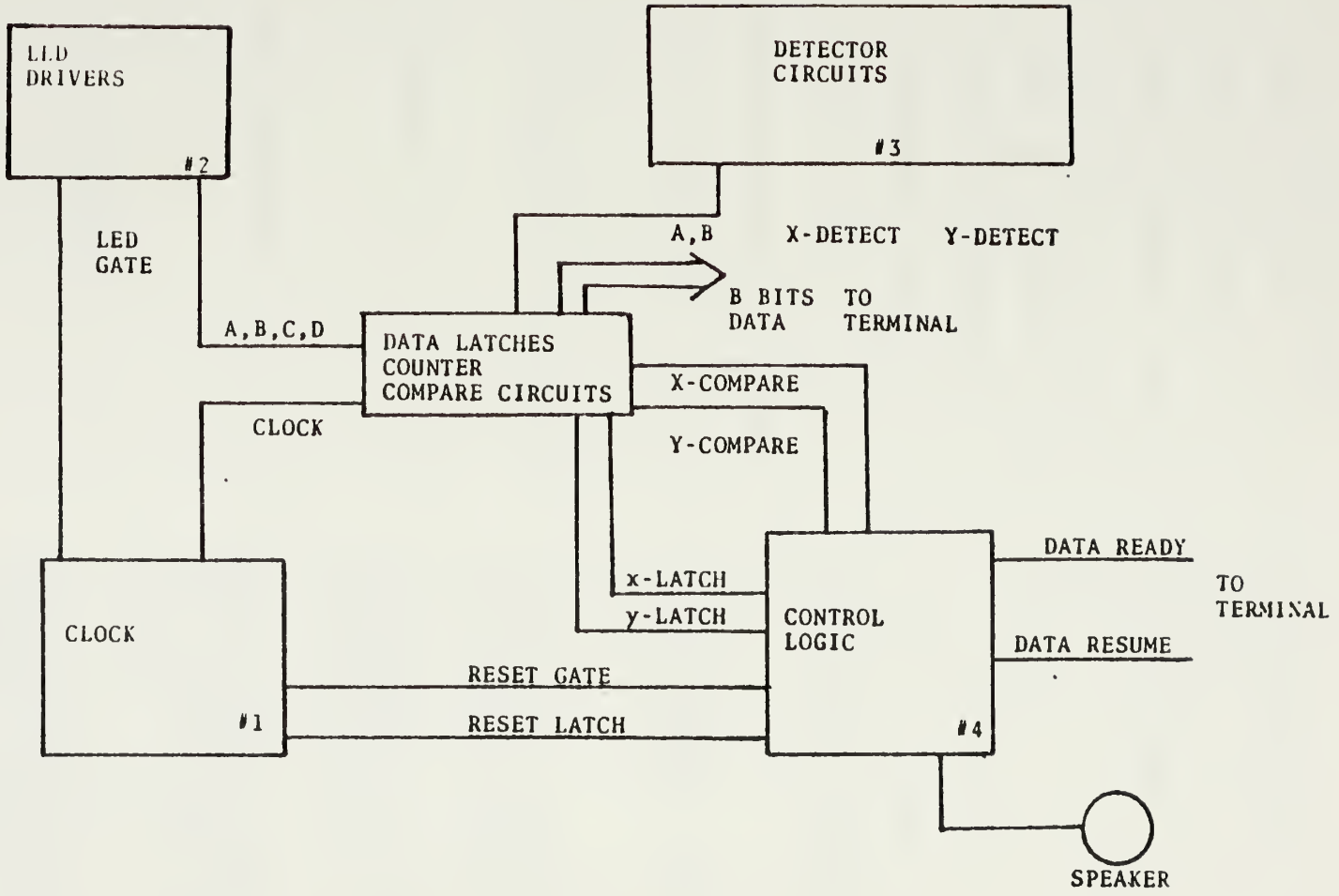


FIGURE 26

APPENDIX H

DATAMEDIA ELITE 2500 TERMINAL DESCRIPTION

A. ELITE 2500 SPECIFICATIONS

1.	SCREEN CAPACITY----------	1920 characters
2.	SCREEN TYPE/SIZE----------	P4 white, 12 inch
3.	SCREEN FILTER----------	Gray or Green
4.	CHARACTERS PER LINE--------	80
5.	LINES OF DISPLAY----------	Up to 24
6.	CHARACTER GENERATION-------	5 x 7 dot matrix
7.	CHARACTER SIZE----------	0.18"H x 0.09"W
8.	CHARACTER SET----------	Full ASCII - upper/lower case, 128 codes stored
9.	REFRESH RATES----------	50 or 60 Hz
10.	DATA RATES----------	50 to 9600bps, synchronous/ asynchronous
11.	MEMORY TYPE----------	MOS
12.	KEYBOARD----------	Electronic, typewriter layout with numeric cluster and cursor controls
13.	CURSOR----------	Addressable X-Y coordinates; non-destructive, non-blinking up, down, right, left, and home
14.	KEY CONTROLS----------	Erase screen, erase foreground data, erase to end of line, tab, print, Xmit, Xmit line, roll on, unlock, I/D, escape, return
15.	SPLIT SCREEN----------	Protected format, variable field tabbing horizontal and vertical. Blink field for computer derived or high light character
16.	OPERATING MODES----------	Full or Half Duplex, Roll or Tape Mode

17.	ALARM----------	Audible on alarm code or eight characters from end of line
18.	INTERFACE-LINE ---------	RS232C; lamp indicators for carrier detect, and clear to send (optional telegraphic interface)
19.	INTERFACE-PRINTER-------	Independent printer output, speed preselectable
20.	VIDEO OUTPUT----------	Provision to drive up to 16 external monitors
21.	DIMENSIONS----------	$14\frac{1}{2}$"H x 20"D x 18"W
22.	WEIGHT----------	50 pounds
23.	POWER----------	100/125V 50/60Hz 150 Watts 200/250V 50/60Hz 150 Watts

B. DESCRIPTION OF CONTROL FUNCTIONS

1. Home (STX) - Will return the cursor to the Home position (first character), first line), unless a protected field is located at home, then it will return cursor to the start of first variable field (end of first protected field).

2. Forward Cursor (FS) - A non-destruct code which will cause the cursor to advance one character position to the right. If there are no character positions to the right, the cursor will advance to the first character position of the next line. If position to the right is a protected field, the cursor will advance to the first character of the next variable field.

3. Back Cursor (BS) - A non-destruct code which will cause the cursor to move one character position to the left. The cursor will not move when it has reached the first character of the line or variable field.

4. Up Row Cursor (SUB) - A non-destruct code which will cause the cursor to move up one row. When the first row is reached, the cursor will remain there. If by moving the cursor up causes it to fall into a protected field, it will then advance to the first character of the next variable field.

5. Down Row Cursor (LF) - A non-destruct code which will move the cursor down one row. When the last row is reached it will move the cursor to the first row. If by moving the cursor down causes it to fall into a protected field, it will then advance to the first character of the next variable field. The (LF) will not function immediately after an automatic new line or a return (CR) code.

6. Return (CR) - A non-destruct code which will move the cursor to the start of the next line or variable field. The return will not function after an automatic new line.

7. Erase (US) - This code will erase all variable field data and position the cursor in the first character of the first variable field. If there is no protected field, it will position the cursor to the home position.

8. Master Clear (RS) - This code will clear the entire memory and home the cursor.

9. Erase to End of Line (ETB) - This code will erase all variable field data from cursor to the end of the line.

10. Start Address (FF) - This code will place the unit in the X-Y addressing mode. The next character will be

character address, and the following character the row address. Data may be typed from that point in the normal manner.

11. Xmit (DC1) - This code will cause the transmission of all data starting at the position of the cursor to the end of the page. All transmissions can be stopped by depressing the Break Key.

Transmission Identifiers

a. Protected field will be identified by the transmission of (S1) ON protected field (CAN) OFF protected field. The field data will not be transmitted.

b. Blink field will be identified by (S0) ON Blink field (CAN) OFF Blink field. Blink field characters are transmitted.

c. Program options:

(1) At the end of each line a carriage return or (CR) (LF) can be sent.

(2) (DC1) (DC2) can cause an automatic home.

(3) (DC3) can cause an automatic carriage return.

(4) The transmission can be blocked by (STX) at the start and (ETX) at the end.

d. Tape Mode Transmission - Transmits everything without adding any identifiers.

12. Xmit Line (DC3) - This code will cause data to be transmitted from the cursor tothe end of the line, with the same transmission identifiers as (DC1).

13. Xmit Printer (DC2) - This code will cause all data to be transmitted to the printer starting at the cursor to the end of the page, adding a carriage return and line feed, and ten rub-out characters at the end of each line. This transmission is done, disregarding any form or Blink field that may exist.

14. Bell (BEL) - When this code is received the alarm will sound. The alarm will sound when the eighth character from the end of the line has been entered from the keyboard, or after a Data Transmission but not a Tape Mode Data Transmission.

15. Form On (SI) - This code will cause all characters sent after it to be in a protected field.

16. Blink On (S0) - This code will cause all characters sent after it to Blink.

17. Roll On (GS) - This code will cause the display to roll up when the cursor is on the last row and a (LF) or (CR) or 80th character is entered. It functions as an interactive mode, terminal to computer and display.

18. Form/Blink/Roll/I/D (CAN) - This code will cause the end to insert protected field, insert Blink, Roll Mode and insert delete.

19. Tab (HT) - When this code is received the cursor will move to the beginning of the next variable field. If no variable fields are found before the Home position, the cursor will stop tabbing at the Home position.

20. Insert Delete (DLE) - (optional) When this code is received, all data following will be entered at the cursor moving existing data over.

C. STANDARD FEATURES

1. PARITY CHECK AND GENERATION

Transmits even parity or mark parity by adding programming Jumper C to D on Transmitter J5. Receiver checks even parity, displaying question mark (?) character if parity errors is detected. The receive parity checker can be removed by removing Jumper AA to BB on receive board J4.

2. SPEED SELECTION

Defined data rates with five data rates selectable or with transmit and receive differentiating in SEL position.

3. FULL OR HALF DUPLEX

Identified by panel lights.

4. ROLL OR PAGE

Identified by panel lights.

5. PAGE TRANSMIT

Full page transmit starting at the cursor.

6. LINE TRANSMIT

Line by line transmit.

7. CURSOR CONTROL

Non-destructive, up, down, right, left, home.

8. AUDIBLE END OF LINE INDICATOR

Audible end of line bell sounds when the 72nd character of a line is entered; also sounds when the "Bell" character is received.

9. LINE CONDITIONS

Lamp indicator on front panel for (CD) carrier detect and (CTS) clear to send.

10. FORM FIELD CHARACTERS

Form field or protected field characters.

11. BLINK FIELD CHARACTER

Blink field character for highlight.

12. CARRIAGE RETURN

Generates automatic carriage return and line feed.

13. X-Y COORDINATES

X-Y coordinates cursor positioning.

14. 105 KEY-KEYBOARD

Not all used.

15. ENCODING OF ALL CONTROL FUNCTIONS

16. 127 AXCII CODES

Stored in tape mode.

D. OPTIONAL FEATURES

1. Current Loop Interface
2. Built-in 1200 Baud Modem
3. Separate Keyboard
4. Printer Xmit
5. Polled, up to 96 terminals can share a single communications line. (May be accommodated)
6. Character and Line Insert Delete

APPENDIX I

OPERATION OF THE "MDSPDP" INTERFACE PROGRAM

NOTE:

It is assumed that the operator is familiar with the Microcomputer Development System (MDS) operation and log-on procedures to the ISIS-II operating system, and log-on procedures to Unix. The operator must have a copy of the MDSPDP interface program in his floppy disk, and a copy of PDPSEND and PDPRECEIVE programs in his Unix directory. After MDS system initialization in the ISIS-II operating system, in order to execute the MDSPDP interface the operator must:

1. Issue the ISIS-II command

   :FX:MDSPDP :FX:FILENAME<CR>

   This command causes the execution and subsequent transfer of system control to the MDSPDP program;

   - :FX: is the designator of the drive in which the respective programs are located, X=0 for drive 0, X=1 for drive 1;
   - (FILENAME) is the name of a particular file to be received or transmitted to or from the MDS. The name should be padded with blanks if it is not 11 characters long; and
   - <CR> is carriage return.

It should be noted that once a file (FILENAME) is entered as an argument with an execution of MDSPDP ..., all transmissions

and receptions to or from the MDS will be to this file. This is especially important when exercising the "round-robin" feature of the interface between the two computer environments.

After entering the command, the CRT will display an echo-back of the :FX:FILENAME, and the status message:

SYSTEM IN NEUTRAL STATE:

and will proceed within 3 to 5 seconds to issue Unix log-in message:

NPS UNIX
NAME:

At this point the operator may enter his (her) user code and password (use lower case). Upon completion of the log-on procedure and prior of execution of PDPSEND or PDPRECEIVE, the operator may utilize the Unix operating system from the MDS CRT terminal as a normal Unix time-sharing terminal.

2. Now, the operator is ready to transfer files:
   a. PDPRECEIVE (transfer a file from floppy disk to PDP): to initiate transfer of a file, the operator must type the following command after the Unix prompt: o/o.

      o/o PDPRECEIVE <FILENAME> <CONTROL/T>

- <FILENAME> is the name of the file being transferred to the operator's Unix directory. The operator has the option of maintaining the original filename of his floppy disk directory file or change the name to a new one; in either case the file or the filename in the floppy disk would not be altered. During the transfer of data, the file will be echoed to the CRT. If the operator desires to abort the transmission he must depress:

<CONTROL / C> <REPEAT>

until the MDSPDP program print to the CRT the following message:

TRANSMIT STATE TERMINATED BY OPERATOR.
PARTIAL FILE CREATED AT PDP.
XXX BYTES TRANSMITTED FROM FLOPPY DISK TO PDP.
LEAVING TRANSMIT STATE: ENTER NEUTRAL STATE SYSTEM IN NEUTRAL STATE
NEUTRAL STATE AND REBOOTING TO ISIS-II
- (prompt of ISIS-II)

xxx is the number of bytes transmitted so far. At this point the operator is back in the ISIS-II operating system, but the user is still logged-on to the PDP unix operating system. The operator must go to step one, initiate and complete a successful transmission, or go to step one, quit from Unix, and type the following command:

<CONTROL / C >

this will generate the following message,

NEUTRAL STATE AND REBOOTING TO ISIS-II
- (prompt of ISIS-II)

If the transmission is successfully completed, the operator will have in his Unix directory, the complete file with the name specified when he issued the command

o/o PDRECEIVE <FILENAME> <CONTROL / T> ,

After a successful transmission the following messages are printed to the CRT:

XXX BYTES TRANSMITTED FROM FLOPPY DISK TO PDP.
LEAVING THE TRANSMIT STATE: ENTER NEUTRAL STATE.
SYSTEM IN NEUTRAL STATE:
o/o (Unix prompt)

xxx is the number of bytes of the file transmitted. At this time the operator may quit Unix, or operate the MDS CRT as a Unix terminal (in the round-robin mode or as indicated in step one), editing the file, then executing PDPSEND (step 2b) to complete the "round-robin" file transfer, and then quit Unix, returning to the ISIS-II operating system, terminating MDSPDP program and data transmission.

b. PDPSEND (transfer a file from the PDP to floppy disk). After going through step one; to initiate transfer

of a file, the operator must type the following command after the Unix prompt: o/o

o/o PDPSEND <FILENAME> <CONTROL/ R>

- <FILENAME> is the name of the user's directory filename to be transferred, the operator has the choice of changing the name of the file to be transferred, this can be accomplished by calling the MDSPDP program (see step one), with the desired file name.
After this command is given the following message will appear in the CRT:

SYSTEM IN RECEIVE STATE:

and the transfer will begin from the file in Unix to the buffer in the MDS microcomputer. The file being transferred will not be echoed in the CRT until the complete file has been received in the buffer and the transfer from the buffer to the floppy disk is initiated, at this time, the echoed will start as well as the writing into the floppy disk.
If the operator desires to abort the transmission of data, he must depress the following keys.

<CONTROL / C> <REPEAT>

(in this case no file will be written in the floppy disk).
until the following messages appear in the CRT:

RECEIVE STATE TERMINATED BY OPERATOR.

NO FILE CREATED AT FLOPPY DISK.

NEUTRAL STATE AND REBOTTING TO ISIS-II.

- (ISIS-II prompt)

This will cause a termination of the MDSPDP program and a rebooting to the MDS ISIS-II operating system. At this point the operator must take the same action in case of transmission abort as explained in section 2.a

After successful transmission from the file at Unix into the MDS floppy-disk, and after receiving the echo of the file in the MDS-CRT the following messages will appear:

PDP PROMPTING : END OF RECEPTION.

PDP BUFFER/FILE WRITTEN TO DISK.

CHARACTER COUNT : XXX BYTES TRANSMITTED FROM PDP TO FLOPPY-DISK.

SYSTEM IN NEUTRAL STATE:

o/o (Unix Prompt)

At this time the operator may quit Unix, operate the MDS terminal as a Unix terminal (in the "round-robin" mode or as indicated in step-one), or execute PDPRECEIVE (step a) to complete the "round-robin" file transfer.

APPENDIX J

PROGRAM LISTINGS

A. STIS. MOD ---------- 198

1. OUTPUTS$STATUS$LP
2. SEND$CHAR$LP
3. PCRLF
4. SEND$STRING$LP
5. INITIALIZE$SCREEN
6. INITIALIZE$PRINTER
7. CLOSE$PRINTER
8. LIST$MENU$COMMANDS
9. LIST$MENU$COMMANDS$LP
10. ORIG$STRUCTURE$WRITE
11. NEW$STRUCTURE$WRITE
12. ORIGPDPWRITE
13. MAKE$ADDRESS
14. LOCATE$STRUCTURE$PDP
15. INT$CHECK
16. INT$3
17. INTE$6
18. MAIN PROGRAM SOURCE CODE

B. SYSTEM. EXT ---------- 200

1. OPEN
2. CLOSE
3. READ
4. WRITE

5. EXIT

6. CONSOL

7. DELETE

8. ERROR

9. RENAME

C. CRT.MOD ----------202

1. SET$TTY$9600

2. SET$TTY$2400

3. OFFCRTKEYBOARD

4. ONCRTKEYBOARD

5. OUTPUT$STATUS$CRT

6. SEND$CHAR$CRT

7. CRLF

8. SEND$STRONG$CRT

9. PRINTTOCRT

10. INPUT$STATUS$PDP

11. PRINT$CHAR$PDP

12. INPUT$STATUS$CRT

13. READ$CHAR$CRT

14. SETLOWHOME

15. CLEARLOWSCREEN

16. CLEAR$NEXT$LINES

17. GET$BYTE

18. CLOCK$TIMER

D. SCREEN.MOD ---------- 272

1. WRITEBIGPICTURE

2. WRITE$LITTLE$PICTURE

3. CONVERT$ADDRESS$TO$CHARTS

4. CONVERT$BYTE$TO$CHARS

5. LOAD$DATA$BIG$PICTURE

6. LOAD$DATA$LITTLE$PICTURE

7. LOAD$LINE$ARRAY

8. BLANK

9. LOAD$BLANKS

10. INITIALIZE$LOAD$PICTURE

11. SET$STRUCTURE$ZEROES

E. WRITE.MOD ---------- 284

1. OUTPUT$STATUS$LP

2. SEND$CHAR$LP

3. LPCRLT

4. WRITEBIGPICTURE$LP

5. WRITE$LITTLE$PICTURE$LP

F. SCREEN.EXT ---------- 213

1. CONVERT$ADDRESS$TO$CHARS

2. CONVERT$BYTES$TO$CHARS

3. WRITEBIGPICTURE$LP

4. WRITEBIGPICTURE

5. WRITE$LITTLE$PICTURE$LP

6. WRITE$LITTLE$PICTURE

7. LOADS$DATA$LITTLE$PICTURE

8. INITIALIZE$LITTLE$PICTURE

9. SET$STRUCTURE$ZEROES

G. GRAPH1MOD ---------- 313

1. INITIALIZE$GRAPHICS
2. SEND$GRID$PLASMA
3. SEND$GRID$PLASMA$2
4. INITIALIZE$STURCTURE
5. DRAW$SHIP$DAST1
6. DRAW$SHIP$DASH$LOOP
7. STRUCTURE$BACK
8. BACKUPS
9. DRAW$SHIP$PROCEDURE

H. GRAPH2MOD ---------- 345

1. DRAW$SHIP$DASH$2
2. DRAW$DASH$LOOP$-
3. DRAW$SHIP$2

I. SERVE.MOD ---------- 323

1. SERVICE$SIX
2. QUAD$NUM

J. GRAPH1.EXT ---------- 217

1. QUAD$NUM
2. INITIALIZE$GRAPHICS
3. INITIALIZE$STRUCTURE
4. SEND$GRID$PLASMA
5. SEND$GRID$PLASMA$2
6. DRAW$SHIP$DASH
7. DRAW$SHIP$DASH$LOOP
8. STRUCTURE$BACK

9. BACKUPS

10. DRAW$SHIPS

11. SERVICE$SIX

12. DRAW$SHIP$DASH$2

13. DRAW$SHIP$DASH$LOOP$2

14. DRAW$SHIP$2

K. PDP.MOD ---------- 353

1. SYSTEM CALLS

2. OUTPUT$STATUS$CRT

3. SET$TTY$2400

4. OUTPUT$STATUS$PDP

5. INPUT$STATUS$CRT

6. INPUT$STATUS$PDP

7. SEND$CHAR$CRT

8. SEND$CHAR$PDP

9. CRLF

10. SEND$STRING$CRT

11. PRINTTOCRT

12. READ$CHAR$CRT

13. READ$CHAR$PDP

14. SET$CHAR$CRT$BUF

15. GET$CHAR$PDP$BUF

16. PUT$CHAR$CRT$BUF

17. PUT$CHAR$PDP$BUF

18. CRTBUFFULL

19. PDPBUFFULL

20. PRINTHEXNUMBER

21. FORMAT$HEX

22. PRINT$CHAR$COUNT

23. INT$CHAR$COUNT

24. COUNT$CHAR

25. INTE$NEUTRAL$STATE

26. INT$RECEIVE$STATE

27. INT$TRANSMIT$STATE

28. BREAK$STATE

29. END$R

30. END$T

31. WRITE$RECORD$TO$DISK

32. WRITEPDPBUFFC

33. REBOOT

34. MAIN BODY OF PDP.MOD

L. PLASMA.MOD ---------- 395

M. PLAPUB.ONE ---------- 406

1. WRITE$CONTACT$ID

2. DRAW$GRID

3. DRAW$FRIEND$SYMBOL

4. DRAW$FRIEND$DASH

5. ERASE$FIREND$DASH

6. ERASE$FRIEND$SYMBOL

7. DRAW$HOSTILE$SYMBOL

8. DRAW$HOSTILE$DASH

9. ERASE$HOSTILE$SYMBOL

10. ERASE$HOSTILE$DASH

N. UNKNOW.SR1 ---------- 422

1. DRAW$UNKNOWN$SYMBOL
2. ERASE$UNKNOWN$SYMBOL
3. DRAW$UNKNOWN$DASH
4. ERASE$UNKNOWN$DASH

O. PLAPUB.TWO ---------- 426

1. WRITE$CONTACT$ID$2
2. DRAW$GRID$TWO
3. DRAW$FRIEND$SYMBOL$2
4. DRAW$FRIEND$DASH$2
5. ERASE$FRIEND$DASH$2
6. ERASE$FRIEND$SYMBOL$2
7. DRAW$HOSTILE$SYMBOL$2
8. DRAW$HOSTILE$DASH$2
9. ERASE$HOSTILE$SYMBOL$2
10. ERASE$HOSTILE$DASH$2

P. UNKNOW.SR2 ---------- 442

1. DRAW$UNKNOWN$SYMBOL$2
2. ERASE$UNKNOWN$SYMBOL$2
3. DRAW$UNKNOWN$DASH$2
4. ERASE$UNKNOWN$DASH$2

Q. PLAEXT.ONE ---------- 395

1. SET$STATUS$PLASMA
2. PLASMA$WRITE
3. CLEAR$PLASMA
4. PLASMA$WRITE$VECTOR

5. PLASMA$PRINT$STRING

6. INITIALIZE$PLASMA

7. SET$VECTOR

8. START$VECTOR$SOLID

9. STOP$VECTOR$SOLID

10. START$VECTOR$DASH

11. STOP$VECTOR$DASH

12. GRAPHIC$DESIGN

13. START$ERASE$VECTOR

14. STOP$ERASE$VECTOR

15. START$ERASE$DASH

16. STOP$ERASE$DASH

R. PLAEXT.TWO ---------- 401

1. SET$STATUS$PLASMA$ 2

2. PLASMA$WRITE $2

3. CLEAR$PLASMA$2

4. PLASMA$WRITE$VECTOR$2

5. PLASMA$PRINT$STRING$2

6. INITIALIZE$PLASMA$2

7. SET$VECTOR$2

8. START$VECTOR$SOLID$2

9. STOP$VECTOR$SOLID$2

10. START$VECTOR$DASH$2

11. STOP$VECTOR$DASH$2

12. GRAPHIC$DESIG$2

13. START$ERASE$VECTOR$2

14. STOP$ERASE$VECTOR$2

15. START$ERASE$DASH$2

16. STOP$ERASE$DASH$2

S. PLAPUB.EXT ---------- 314

T. PSPRIM.SRC ---------- 447

1. SETS$STATUS$PLASMA

2. PLASMA$WRITE

3. CLEAR$PLASMA

4. PLASMA$WRITE$VECTOR

5. PLASMA$PRINT$STING

6. INITIALIZE$PLASMA

7. SET$VECTOR

8. SET$VECTOR$ONE

9. START$VECTOR$SOLID

10. STOP$VECTOR$SOLID

11. START$VECTOR$DASH

12. STOP$VECTOR$DASH

13. GRAPHIC$DESIG

14. START$ERASE$VECTOR

15. STOP$ERASE$VECTOR

16. START$ERASE$DASH

17. STOP$ERASE$DASH

U. PSPR2.SRC ---------- 469

1. SET$STATUS$PLASMA$2

2. PLASMA$WRITE$2

3. CLEAR$PLASMA$2

4. PLASMA$WRITE$VECTOR$2

5. PLASMA$PRINT$STRING$2

6. INITIALIZE$PLASMA$2

7. SET$VECTOR$2

8. SET$VECTOR$ONE$2

9. START$VECTOR$SOLID$2

10. STOP$VECTOR$SOLID$2

11. START$VECTOR$DASH$2

12. STOP$VECTOR$DASH$2

13. GRAPH1$DESIGN$2

14. START$ERASE$VECTOR$2

15. STOP$ERASE$VECTOR$2

16. START$ERASE$DASH$2

17. STOP$ERASE$DASH$2

V. STIS.C ---------- 489

1. MAIN

2. INISTRU

3. INTO

4. SENDDATA

5. EOT

6. COMPUTE

7. LDLAT

8. LDLONG

9. LDCOUR

10. QUADNUM

11. LDRANG

12. LDBEAR

13. LDCPATD

W. MDSPDP.SRC ---------- 516

1. HANDLER

2. PDPRECEIVE.C

3. PDPSEND.C

```
ISIS-II PL/M-80 V3.1 COMPILATION OF MODULE SYSTEMMODULE
NO OBJECT MODULE REQUESTED
COMPILER INVOKED BY:  PLM80 :F1:STIS.MOD NOOBJECT PAGEWIDTH(82) PAGE
LENGTH(24) DAT
                    -E(MAY 1979) TITLE('MODULE STIS.MOD')



              /* THIS MODULE CONTAINS PROCEDURES TO DRAW SYMBOLS TO
THE
                   PLASMA DEVICES AND INTERACT WITH PLASMA TOUCH-PAN
EL. */

   1          SYSTEM$MODULE:
              DO;
   2    1     DECLARE LIT LITERALLY 'LITERALLY';
   3    1     DECLARE DCL LIT 'DECLARE';
   4    1     DCL TRUE LIT '0FFH';
   5    1     DCL FALSE LIT '000H';
   6    1     DCL LOC$18H ADDRESS AT (18H);
   7    1     DCL LOC$19H ADDRESS AT (19H);
   8    1     DCL LOC$30H ADDRESS AT (30H);
   9    1     DCL LOC$31H ADDRESS AT (31H);
  10    1     DCL STRUCTURE$COUNT BYTE;
```

```
  11   1       DCL (TEST$CHAR,IDA,IDB) BYTE;
  12   1       DCL XY ADDRESS;
  13   1       DCL Z BYTE;
  14   1       DCL OK BYTE;
  15   1       DCL PLASMA$SWITCH BYTE;
  16   1       DCL PRINT$TEMP BYTE;
  17   1       DCL COMMAND$MENU BYTE;
  18   1       DCL SCREEN$PRINT BYTE;
  19   1       DCL XY1 BYTE;
  20   1       DCL XY2 BYTE;
  21   1       DCL RECEIVE$PRINT BYTE PUBLIC;
  22   1       DCL STR$NM (*) BYTE INITIAL (':F1:NEW.STR         ');
  23   1       DCL STR$OR$NM (*) BYTE INITIAL (':F1:ORIG.STR
);
  24   1       DCL PDP$NM (*) BYTE INITIAL (':F1:ORIG.PDP        ');
  25   1       DCL (OPEN$STATUS,
                    CLOSE$STATUS,
                    CONSOL$STATUS,
                    AFT$IN,
                    WRITE$STATUS) ADDRESS;
```

```
                $INCLUDE(:F1:SYS.EXT)
            =       /*ISIS-II SYSTEM CALLS: ***********/
            =
            =
  26    1   =       OPEN:
            =           PROCEDURE (AFT,FILE,ACCESS,MODE,STATUS ) EXTER
NAL;
  27    2   =                 DECLARE (AFT,FILE,ACCESS,MODE,STATUS )AD
DRESS;
  28    2   =       END OPEN;
            =
            =
  29    1   =       CLOSE:
            =            PROCEDURE(AFT,STATUS) EXTERNAL;
  30    2   =                 DCL (AFT,STATUS) ADDRESS;
  31    2   =       END CLOSE;
            =
            =
  32    1   =       READ:
            =           PROCEDURE(AFT,BUFFER,COUNT,ACTUAL,STATUS) EXTE
RNAL;
  33    2   =             DCL(AFT,BUFFER,COUNT,ACTUAL,STATUS) ADDRESS;
  34    2   =       END READ;
```

```
                =
                =
 35    1        =        WRITE:
                =             PROCEDURE(AFT,BUFFER,COUNT,STATUS) EXTERNAL;
 36    2        =                 DCL(AFT,BUFFER,COUNT,STATUS) ADDRESS;
 37    2        =        END WRITE;
                =
                =
                =
 38    1        =        EXIT:
                =            PROCEDURE EXTERNAL;
 39    2        =              DCL STATUS ADDRESS;
 40    2        =        END EXIT;
                =
                =
                =
 41    1        =        CONSOL:
                =              PROCEDURE(INFILE,OUTFILE,STATUS) EXTERNAL;
 42    2        =                    DCL (INFILE,OUTFILE,STATUS) ADDRESS;
 43    2        =        END CONSOL;
                =
```

```
            =
            =
 44    1    =        DELETE:
            =              PROCEDURE(FILE,STATUS) EXTERNAL;
 45    2    =                DCL(FILE,STATUS) ADDRESS;
 46    2    =        END DELETE;
            =
            =
            =
 47    1    =        ERROR:
            =             PROCEDURE (ERRNUM) EXTERNAL;
 48    2    =               DCL (ERRNUM) ADDRESS;
 49    2    =        END ERROR;
            =
            =
 50    1    =        RENAME:
            =              PROCEDURE(OLDFILE,NEWFILE,STATUS) EXTERNAL;
 51    2    =                DCL(OLDFILE,NEWFILE,STATUS) ADDRESS;
 52    2    =        END RENAME;
            =
            $INCLUDE(:F1:CRT.DEC)
```

```
          =    /* THIS MODULE CONTAINS DECLARATIONS TO INTERACT WITH
THE MDS CRT .
           -    */
          =
          =
          =
          =
  53   1  =          SET$TTY$9600: PROCEDURE;
          =
          =             /* SET TTY BAUD RATE TO 9600 */
  54   2  =                OUTPUT(245)=40H;
  55   2  =                OUTPUT(245)=4EH;
  56   2  =                OUTPUT(245)=37H;
  57   2  =             END;
          =
          =
          =
  58   1  =           SET$TTY$2400: PROCEDURE;
          =
          =             /* SET TTY BAUD RATE TO 2400 */
  59   2  =                OUTPUT(245)=40H;
  60   2  =                OUTPUT(245)=4FH;
```

```
61   2  =                OUTPUT(245)=37H;
62   2  =              END;
        =
        =
63   1  =    OFF$CRT$KEYBOARD: PROCEDURE;
        =
        =   /* SET CRT USART RECEIVER TO DISABLE */
64   2  =   OUTPUT(247) = 40H;
65   2  =   OUTPUT(247) = 4FH;
66   2  =   OUTPUT(247) = 33H;
67   2  =   END; /* OFF$CRT$KEYBOARD */
        =
        =
        =
68   1  =   ON$CRT$KEYBOARD: PROCEDURE;
        =
        =   /* SET CRT USART RECEIVER TO ENABLE */
69   2  =   OUTPUT(247) = 40H;
70   2  =   OUTPUT(247) = 4FH;
71   2  =   OUTPUT(247) = 37H;
72   2  =   END; /* ON$CRT$KEYBOARD */
```

```
                =
                =
                =
 73    1        =      OUTPUT$STATUS$CRT: PROCEDURE BYTE;
                =
                =      /* TRUE IF DATA OUTPUT LINE TO CRT READY */
 74    2        =         RETURN ROR (INPUT(247),2);
 75    2        =      END;
                =
                =
 76    1        =      SEND$CHAR$CRT: PROCEDURE (CHAR) ;
                =
                =      /* PRINT A CHARACTER TO THE CRT */
 77    2        =         DCL CHAR BYTE;
 78    2        =           DO WHILE NOT OUTPUT$STATUS$CRT;
 79    3        =           END;
 80    2        =           OUTPUT(246)= CHAR;
 81    2        =      END;
                =
                =
                =
```

```
                =           /* CRLF: */
  82    1       =       CRLF: PROCEDURE ;
                =
                =       /* SEND CARRIAGE RETURN AND LINE FEED TO THE CRT *
/
  83    2       =          CALL SEND$CHAR$CRT(0DH);
  84    2       =          CALL SEND$CHAR$CRT(0AH);
  85    2       =       END;
                =
                =
                =
  86    1       =       SEND$STRING$CRT: PROCEDURE (STRING$ADDRESS);
                =
                =       /* SEND MESSAGE AT STRING$ADDRESS UNTIL '$' IS
                =          DETECTED */
  87    2       =          DCL STRING$ADDRESS ADDRESS;
  88    2       =          DCL TEMPCHAR BASED STRING$ADDRESS BYTE;
  89    2       =          DO WHILE TEMPCHAR <> '$';
  90    3       =          CALL SEND$CHAR$CRT(TEMPCHAR);
  91    3       =          STRING$ADDRESS=STRING$ADDRESS + 1;
  92    3       =          END;
  93    2       =       END;
```

```
          =
          =
          =
 94   1   =        PRINT$TO$CRT: PROCEDURE (STRING$ADDRESS) ;
          =
          =        /* PRINT A STRING TO THE CRT */
 95   2   =           DCL STRING$ADDRESS ADDRESS;
 96   2   =            CALL CRLF;
 97   2   =            CALL SEND$STRING$CRT(STRING$ADDRESS);
 98   2   =            CALL CRLF;
 99   2   =        END;
          =
          =
100   1   =        INPUT$STATUS$PDP: PROCEDURE BYTE ;
          =
          =        /* TRUE IF DATA INPUT LINE FROM PDP READY */
101   2   =           RETURN ROR(INPUT(245),1) ;
102   2   =        END;
          =
          =
103   1   =        READ$CHAR$PDP:PROCEDURE BYTE;
```

```
          =       /* READ A CHARACTER FROM THE PDP */
104   2   =          DCL CHAR BYTE;
105   2   =          CHAR= INPUT (244) AND 07FH;
          =          /* CONVERT LOWER TO UPPER CASE */
106   2   =          IF (CHAR >=61H) AND (CHAR<=7AH) THEN
107   2   =          RETURN CHAR AND 0DFH;
108   2   =          RETURN CHAR;
109   2   =       END;
          =
          =
          =
110   1   =   INPUT$STATUS$CRT: PROCEDURE BYTE;
          =
          =   /* TRUE IF DATA INPUT LINE FROM CRT READY */
111   2   =   RETURN ROR(INPUT(247),1);
112   2   =   END;
          =
          =
          =
113   1   =   READ$CHAR$CRT: PROCEDURE BYTE;
          =
```

```
                =   /* READ A CHARACTER FROM THE CRT */
 114    2       =   DCL CHAR BYTE;
 115    2       =   DO WHILE NOT INPUT$STATUS$CRT;
 116    3       =   END;
 117    2       =   CHAR=INPUT(246);
 118    2       =   IF CHAR >= 80H THEN CHAR=CHAR XOR 80H;
 120    2       =   RETURN CHAR;
 121    2       =   END;
                =
                =
                =
 122    1       =   SET$LOW$HOME: PROCEDURE ;
                =
                =   /* THIS PROCEDURE LOCATES CURSOR AT COLUMN IN ROW 19.
*/
 123    2       =   DCL HOME LIT '02H';
 124    2       =   DCL LF LIT '0AH';
 125    2       =   DCL I BYTE;
 126    2       =   CALL SEND$CHAR$CRT(HOME);
 127    2       =   DO I = 1 TO 19;
 128    3       =      CALL SEND$CHAR$CRT(LF);
 129    3       =   END;
```

```
130   2  =    CALL SEND$CHAR$CRT(017H); /* CLEAR LOW HOME */
131   2  =    END;
           =
           =
           =
132   1  =    CLEAR$LOW$SCREEN: PROCEDURE;
           =
           =    /* THIS PROCEDURE WILL CLEAR ROWS 19 THRU 24 */
133   2  =    DCL I BYTE;
134   2  =    DCL ETEOL LIT '17H';
135   2  =    DCL LF LIT '0AH';
136   2  =    CALL SET$LOW$HOME;
137   2  =    CALL SEND$CHAR$CRT(ETEOL);
138   2  =    DO I = 1 TO 4;
139   3  =       CALL SEND$CHAR$CRT(LF);
140   3  =       CALL SEND$CHAR$CRT(ETEOL);
141   3  =    END; /* DO I */
142   2  =    CALL SET$LOW$HOME;
143   2  =    END;
           =
           =
```

```
                =
 144    1       =    CLEAR$NEXT$LINES: PROCEDURE(X);
                =
                =    /* THIS PROCEDURE CLEARS X NUMBER OF NEXT LINES */
 145    2       =    DCL (I,X) BYTE;
 146    2       =    DCL ETEOL LIT '17H';
 147    2       =    DCL LF LIT '0AH';
 148    2       =    DO I = 1 TO X;
 149    3       =       CALL SEND$CHAR$CRT(ETEOL);
 150    3       =       CALL SEND$CHAR$CRT(LF);
 151    3       =    END; /* DO I */
 152    2       =    END;
                =
                =
                =
 153    1       =    GET$BYTE: PROCEDURE(DIGITS) BYTE ;
                =
                =    /* THIS PROCEDURE IS USED TO OBTAIN A DECIMAL NUMBER B
ETWEEN 0 AND
                =          255 FROM THE CRT KEYBOARD. */
 154    2       =    DCL RUB LIT '07FH';
 155    2       =    DCL BS LIT '08H';
```

```
156   2  =    DCL BEL LIT '07H';
157   2  =    DCL (NUMBER,DIGITS,CHAR,COUNT) BYTE;
158   2  =    NUMBER,COUNT = 0;
159   2  =    DO WHILE DIGITS > 0;
160   3  =       CHAR = READ$CHAR$CRT;
161   3  =       DO WHILE (((CHAR < '0') OR ( CHAR > '9')) AND (CHAR
<> RUB)) OR
         =                  ((CHAR = RUB) AND (COUNT = 0));
162   4  =          CALL SEND$CHAR$CRT(BEL);
163   4  =          CHAR=READ$CHAR$CRT;
164   4  =       END; /* WHILE */
165   3  =       IF CHAR <> RUE THEN
166   3  =          DO;
167   4  =          CALL SEND$CHAR$CRT(CHAR);
168   4  =          NUMBER=NUMBER*10+(CHAR-30H);
169   4  =          COUNT=COUNT+1;
170   4  =          DIGITS=DIGITS-1;
171   4  =       END; /*IF */
         =       ELSE
172   3  =          DO;
173   4  =          NUMBER=NUMBER/10;
174   4  =          CALL SEND$CHAR$CRT(BS);
```

```
175   4  =          COUNT=COUNT-1;
176   4  =          DIGITS=DIGITS+1;
177   4  =       END; /*ELSE */
178   3  =    END; /* WHILE DIGITS */
179   2  =    RETURN NUMBER;
180   2  =    END GET$BYTE;
         =
         =
181   1  =    CLOCK$TIMER: PROCEDURE (X) ;
         =
         =     /* TIME DELAY : X IN SECONDS */
182   2  =    DCL (X,Y) ADDRESS ;
183   2  =    DO Y=1 TO (X*22);
184   3  =       CALL TIME(250);
185   3  =    END; /* DO Y */
186   2  =    END; /* CLOCK$TIMER */
              $INCLUDE(:F1:SCREEN.EXT)
         =
         =    /* EXTERNAL DECLARATIONS FOR SCREEN.MOD */
187   1  =    DCL CONVERTED$BYTE$NUMBER (5) BYTE EXTERNAL;
188   1  =    DCL ERASE$COUNT ADDRESS EXTERNAL;
```

```
          =
 189   1  =    CONVERT$ADDRESS$TO$CHARS: PROCEDURE (CHAR$ADDRESS) EXT
ERNAL;
 190   2  =    DCL SCALE$FACTOR (5) ADDRESS DATA (10000,1000,100,10,1
);
 191   2  =    DCL (JA,IA,PASS$COUNT) BYTE;
 192   2  =    DCL (CHAR,TEMP,CHAR$ADDRESS) ADDRESS;
 193   2  =    END;
          =
          =
          =
          =
 194   1  =    CONVERT$BYTE$TO$CHARS: PROCEDURE (CHAR$BYTE) EXTERNAL;
 195   2  =    DCL SCALE$FACTOR (3) BYTE DATA (100,10,1);
 196   2  =    DCL (JB,IB,CHAR,CHAR$BYTE,PASS$COUNT,TEMP) BYTE;
 197   2  =    END;
          =
          =
          =
 198   1  =    WRITE$BIGPICTURE$LP: PROCEDURE EXTERNAL;
 199   2  =    DCL (I,J,K) ADDRESS;
 200   2  =    END;
          =
```

```
          =
          =
 201   1  =    WRITE$BIGPICTURE: PROCEDURE EXTERNAL;
 202   2  =    DCL (I,J,K) ADDRESS;
 203   2  =    END;
          =
          =
          =
 204   1  =    WRITE$LITTLEPICTURE$LP: PROCEDURE EXTERNAL;
 205   2  =    DCL (L,M,N) ADDRESS;
 206   2  =    END;
          =
          =
          =
 207   1  =    WRITE$LITTLEPICTURE: PROCEDURE EXTERNAL;
 208   2  =    DCL (L,M,N) ADDRESS;
 209   2  =    END;
          =
          =
          =
 210   1  =    LOAD$DATA$LITTLEPICTURE: PROCEDURE (ILITTLE,JLITTLE) E
XTERNAL;
```

```
 211   2  =    DCL (I,J,ILITTLE,JLITTLE) BYTE;
 212   2  =    DCL (N,K) BYTE;
 213   2  =    END;
            =
            =
            =
 214   1  =    INITIALIZE$LOAD$PICTURE: PROCEDURE (C) EXTERNAL;
 215   2  =    DCL (C,F) ADDRESS;
 216   2  =    DCL (INDEX,SHIPINDEX,D,E) BYTE;
 217   2  =    DCL T$COUNT ADDRESS;
 218   2  =    END;
            =
            =
            =
 219   1  =    SET$STRUCTURE$ZEROES: PROCEDURE (PTR,P$COUNT) EXTERNAL
;
 220   2  =    DCL (PTR,P$COUNT) ADDRESS;
 221   2  =    DCL ZERO$COUNTER ADDRESS;
 222   2  =    DCL P BASED PTR BYTE;
 223   2  =    END;
            =
            =
```

```
                $INCLUDE(:F1:GRAPH1.EXT)
          =
          =
224   1   =    DECLARE SHIP$PLOT (15) STRUCTURE (
          =              LAT(10) ADDRESS,
          =              LONG(10) ADDRESS,
          =              COURSE (10) ADDRESS,
          =              SPEED(10) BYTE,
          =              X$BOW(10) ADDRESS,
          =              Y$BOW(10) ADDRESS,
          =              QUADRANT(10) BYTE,
          =              RANGE(10) ADDRESS,
          =              BEARING(10) ADDRESS,
          =              COLLISION$FLAG(10) BYTE,
          =              CPA$TIME(10) ADDRESS,
          =              CPA$DISTANCE(10) ADDRESS,
          =              COUNT BYTE ) EXTERNAL ;
          =
          =
          =
225   1   =    QUAD$NUM : PROCEDURE (X,Y) EXTERNAL;
```

```
 226   2  =     DCL (X,Y) ADDRESS;
 227   2  =     DCL QUADRANT$NUM BYTE ;
 228   2  =    END;
            =
            =
            =
 229   1  =    INITIALIZE$GRAPHICS: PROCEDURE EXTERNAL;
            =
            =    /* THIS PROCEDURE INITIALIZES PLASMA DEVICES FOR GRAPH
ICS */
 230   2  =    END;
            =
            =
 231   1  =    INITIALIZE$STRUCTURE: PROCEDURE EXTERNAL;
            =
            =    /* THIS A PROCEDURE TO INITIALIZE STRUCTURE TO TEST MO
DULE STAND-ALO
             -    NE. */
 232   2  =    DCL (A0,B0,C0,D0,E0,F0,G0,H0) ADDRESS;
 233   2  =    END; /* INITIALIZE$STRUCTURE */
            =
            =
 234   1  =    SEND$GRID$PLASMA: PROCEDURE EXTERNAL;
```

```
 235   2  =    END;
            =
            =
 236   1  =    SEND$GRID$PLASMA$2: PROCEDURE EXTERNAL;
 237   2  =    END;
            =
            =
 238   1  =    DRAW$SHIP$DASH: PROCEDURE (A1) EXTERNAL;
            =
            =       /*  THIS PROCEDURE DRAWS DASHED SHIPS IN THE PLASMA
DISPLAY
            =            (DEVICE ONE). */
 239   2  =    DCL (A1,SHIPINDEX,INDEX) BYTE ;
 240   2  =    END; /* DRAW$SHIP$DASH */
            =
            =
            =
 241   1  =    DRAW$SHIP$DASH$LOOP: PROCEDURE (A2) EXTERNAL;
            =
            =       /* THIS PROCEDURE DRAWS BACKUP DASH SHIP POSITIONS
*/
 242   2  =    DCL (A2,B2,C2) BYTE ;
 243   2  =    END; /* DRAW$SHIP$DASH$LOOP */
```

```
          =
          =
 244   1  =    STRUCTURE$BACK: PROCEDURE (A3) EXTERNAL;
          =
          =      /* THIS PROCEDURE TRANSFERS SHIP STRUCTURE SET (3) T
O NEXT
          =          ADJACENT BACKUP SHIP STRUCTURE SET.   */
 245   2  =    DCL (A3,B,C,D,E) BYTE;
 246   2  =    END; /* STRUCTURE$BACK */
          =
          =
          =
 247   1  =    BACKUPS: PROCEDURE (A4) EXTERNAL;
          =
          =     /* THIS PROCEDURE TRANSFERS BACKUP STRUCTURES IN FIFO
 QUEUE. */
 248   2  =    DCL (A4,B4,C4) BYTE;
 249   2  =    END; /* BACKUPS */
          =
          =
 250   1  =    DRAW$SHIP:PROCEDURE (TAIL) EXTERNAL;
          =
          =    /*THIS PROCEDURE DRAW SHIPS IN THE PLASMA DISPLAY (DEV
ICE ONE) */
```

```
 251   2  =   DCL(A,TAIL) BYTE;
 252   2  =   DCL (X1,Y1,X2,Y2,B,C ) ADDRESS;
 253   2  =   DCL (ZINDEX,ZSHIPINDEX) BYTE;
 254   2  =   END; /* DRAW$SHIP */
            =
            =
 255   1  =   SERVICE$SIX: PROCEDURE EXTERNAL;
            =
            =    /* THIS PROCEDURE SERVICE THE INTERRUPTS CAUSED BY
            =       THE PLASMA(DEVICE ONE) TOUCH-PANEL DEVICE.   */
            =
 256   2  =    DCL (XY$DATAWORD,XY$DATAWORD$1,X$COOR,Y$COOR,INDEX,
            =         SHIPINDEX,FOUND$SHIP,QUADRANT$NUM,OWNSHIP) BYTE;
 257   2  =   END; /* SERVICE SIX */
            =
            =
            =
 258   1  =   DRAW$SHIP$DASH$2: PROCEDURE (A1) EXTERNAL;
            =
            =   /* THIS PROCEDURE DRAWS DASHED SHIPS IN THE PLASMA DIS
PLAY
            =       (DEVICE TWO). */
```

```
 259   2  =    DCL (A1,SHIPINDEX,INDEX) BYTE;
 260   2  =    END;
            =
            =
 261   1  =     DRAW$SHIP$DASH$LOOP$2: PROCEDURE (A2) EXTERNAL;
            =
            =    /* THIS PROCEDURE DRAWS BACKUP DASH SHIP POSITIONS */
 262   2  =    DCL (A2,B2,C2) BYTE;
 263   2  =    END;
            =
            =
            =
 264   1  =    DRAW$SHIP$2: PROCEDURE (TAIL) EXTERNAL;
            =
            =    /* THIS PROCEDURE DRAW SHIPS IN THE PLASMA DISPLAY (DE
VICE TWO) */
 265   2  =    DCL (A,TAIL) BYTE;
 266   2  =    DCL (X1,Y1,X2,Y2,B,C) ADDRESS;
 267   2  =    DCL (ZINDEX,ZSHIPINDEX) BYTE;
 268   2  =    END;
            =
            =
```

```
                $INCLUDE(:F1:TIME.SRC)
            =   /* BEGIN DECLARATIONS FOR INTERRUPT DRIVEN CLOCK */
            =
            =
            =
 269   1    =   DCL (MILI$SEC,DUMMY$SEC,SECONDS,MINUTES,HOURS,DAY,MONT
H,YEAR,SEC$TIM
             -   F)
            =        BYTE PUBLIC;
 270   1    =   DCL TIME$STEP ADDRESS PUBLIC;
 271   1    =   DCL TIME$BUFFER(6) BYTE PUBLIC;
 272   1    =   DCL TIME$ARRAY (*) BYTE INITIAL
            =   (' TIME:   :  :   DATE:   /  /
223
             -          ');
            =
 273   1    =   DCL M0 (73) BYTE EXTERNAL ;
 274   1    =   DCL LOC$38 ADDRESS AT (038H);
 275   1    =   DCL LOC$39 ADDRESS AT (039H);
            =
            =
            =
 276   1    =   INITIALIZE$M0$ARRAY: PROCEDURE ;
```

```
                =
                =     /* THIS PROCEDURE INITIALIZES DATE/TIME FORMAT. */
 277    2       =     DCL I BYTE ;
 278    2       =     DO I=0 TO 72;
 279    3       =        M0(I)=TIME$ARRAY(I);
 280    3       =     END; /* DO I */
 281    2       =     END;
                =
                =
                =
                =
                =
                =
 282    1       =     CLOCK: PROCEDURE INTERRUPT 7;
                =
                =     /* THIS PROCEDURE IS CALLED EACH TIME AN INTERRUPT FRO
M THE REAL TIM
                -     E
                =          CLOCK IN THE MDS SYSTEM, IS PRODUCED. */
 283    2       =     DCL TEMP BYTE;
                =     /* TO RESET THE MDS REAL TIME CLOCK. */
 284    2       =     OUTPUT(0FFH) = 03H;
```

```
285   2  =    MILI$SEC = MILI$SEC + 1;
286   2  =    IF MILI$SEC = 128 THEN DO;
288   3  =       MILI$SEC = 0;
289   3  =       DUMMY$SEC = DUMMY$SEC + 1;
290   3  =    END; /* IF */
291   2  =    IF DUMMY$SEC = 08H THEN DO;
293   3  =       MILI$SEC,DUMMY$SEC = 0;
294   3  =       SEC$TIME = 0FFH;
295   3  =       SECONDS = SECONDS + 1;
296   3  =       TIME$STEP = TIME$STEP + 1;
297   3  =       IF SECONDS = 60 THEN DO;
299   4  =          SECONDS = 00;
300   4  =          MINUTES = MINUTES + 1;
301   4  =          IF MINUTES = 60 THEN DO;
303   5  =             MINUTES = 00;
304   5  =             HOURS = HOURS + 1;
305   5  =             IF HOURS = 24 THEN DO;
307   6  =                HOURS = 00;
308   6  =                DAY = DAY + 1;
309   6  =             END; /* HOURS */
310   5  =          END; /* MINUTES */
```

```
 311    4  =       END; /* SECONDS */
 312    3  =    END; /* DUMMY$SEC */
           =    /* DISABLE INTERRUPTS */
 313    2  =    DISABLE;
           =    /* RESTORE CURRENT OPERATING LEVEL. */
 314    2  =    OUTPUT(0FDH) = 020H;
           =    /* SET THE MDS REAL TIME CLOCK. */
 315    2  =    TEMP = INPUT(0FFH);
 316    2  =    TEMP = INPUT(0FFH);
 317    2  =    OUTPUT(0FFH) = 00H;
           =    /* THE RETURN STATEMENT WILL ENABLE INTERRUPTS AUTOMAT
ICALLY . */
 318    2  =    RETURN;
 319    2  =    END; /* CLOCK */
           =
           =
           =
 320    1  =    LOAD$TIME: PROCEDURE ;
           =
           =     /* THIS PROCEDURE LOADS CURRENT TIME TO ARRAY 'M0' .
*/
           =    /* LOAD HOURS */
 321    2  =    CALL CONVERT$BYTE$TO$CHARS(HOURS);
```

```
322   2  =     M0(8)=CONVERTED$BYTE$NUMBER(1);
323   2  =     M0(9)=CONVERTED$BYTE$NUMBER(0);
           =  /* LOAD MINUTES */
324   2  =     CALL CONVERT$BYTE$TO$CHARS(MINUTES);
325   2  =     M0(11)=CONVERTED$BYTE$NUMBER(1);
326   2  =     M0(12)=CONVERTED$BYTE$NUMBER(0);
           =  /* LOAD SECONDS */
327   2  =     CALL CONVERT$BYTE$TO$CHARS(SECONDS);
328   2  =     M0(14)=CONVERTED$BYTE$NUMBER(1);
329   2  =     M0(15)=CONVERTED$BYTE$NUMBER(0);
           =  /* LOAD MONTH */
330   2  =     CALL CONVERT$BYTE$TO$CHARS(MONTH);
331   2  =     M0(24)=CONVERTED$BYTE$NUMBER(1);
332   2  =     M0(25)=CONVERTED$BYTE$NUMBER(0);
           =  /* LOAD DAY */
333   2  =     CALL CONVERT$BYTE$TO$CHARS(DAY);
334   2  =     M0(27)=CONVERTED$BYTE$NUMBER(1);
335   2  =     M0(28)=CONVERTED$BYTE$NUMBER(0);
           =  /* LOAD YEAR */
336   2  =     CALL CONVERT$BYTE$TO$CHARS(YEAR);
337   2  =     M0(30)=CONVERTED$BYTE$NUMBER(1);
```

```
 338   2  =     M0(31)=CONVERTED$BYTE$NUMBER(0);
 339   2  =   END; /* LOAD TIME */
            =
            =
            =
            =
 340   1  =   ERASE$LINE: PROCEDURE;
            =
            =   /* ERASE PRESENT LINE */
 341   2  =   CALL SEND$CHAR$CRT(017H);
 342   2  =   END;
            =
            =
            =
 343   1  =   CHECK$YES$NO: PROCEDURE BYTE;
            =
            =   /* THIS PROCEDURE USED TO CHECK FOR A VALID YES/NO INP
UT FROM THE CR
              -   T. */
 344   2  =   DCL CHAR BYTE;
 345   2  =   CHAR=READ$CHAR$CRT;
 346   2  =   DO WHILE (CHAR <> 'Y') AND (CHAR <> 'N') /* UPPER CASE
 */
```

```
          =          AND (CHAR<>'y') AND (CHAR<>'n'); /* LOWER CASE
*/
 347   3  =       CALL SEND$CHAR$CRT(07H); /* BELL */
 348   3  =       CHAR = READ$CHAR$CRT;
 349   3  =    END; /* WHILE */
 350   2  =    IF (CHAR='Y') OR (CHAR='y') THEN
 351   2  =       DO;
 352   3  =       CALL SEND$STRING$CRT(.(' YES$'));
 353   3  =       RETURN 1;
 354   3  =       END; /* IF */
          =    ELSE
 355   2  =       DO;
 356   3  =       CALL SEND$STRING$CRT(.('NO $'));
 357   3  =       RETURN 0;
 358   3  =    END; /* ELSE */
          =
 359   2  =    END; /* CHECK$YES$NO */
          =
          =
          =
 360   1  =    CHECK$INPUT: PROCEDURE BYTE ;
          =
```

```
          =    /* THIS PROCEDURE USED TO CHECK THE VALIDITY OF THE IN
PUT PRESENT AT
          -       THAT
          =         MOMENT IN THE SCREEN .*/
 361   2  =    DCL CHAR BYTE;
 362   2  =    CALL CRLF;
 363   2  =    CALL SEND$STRING$CRT(.('IS INPUT DATA CORRECT? (Y/N) $
'));
 364   2  =    CHAR=CHECK$YES$NO;
 365   2  =    RETURN CHAR;
 366   2  =    END; /* CHECK$INPUT */
          =
          =
          =
 367   1  =    BACK$SPACE$ERASE: PROCEDURE (X) ;
 368   2  =    DCL (X,Y) BYTE ;
 369   2  =    DO Y = 1 TO X;
 370   3  =       CALL SEND$CHAR$CRT(08H);
 371   3  =    END;
 372   2  =    CALL ERASE$LINE;
 373   2  =    END;
          =
          =
```

```
 374   1   =    INITIATE$TIME: PROCEDURE ;
             =
             =    /* THIS PROCEDURE IS USED TO SET THE SIMULATED REAL TI
ME CLOCK. */
 375   2   =    DCL OK BYTE;
 376   2   =    DISABLE;
 377   2   =    OK = 0;
 378   2   =    DO WHILE OK = 0;
 379   3   =       YEAR,MONTH,DAY,HOURS,MINUTES,SECONDS = 0FFH;
 380   3   =       CALL SEND$STRING$CRT(.('INPUT DATE AND TIME. $'));
 381   3   =       CALL CRLF;
 382   3   =       DO WHILE YEAR >= 90;
 383   4   =          CALL SEND$STRING$CRT(.(' YEAR: $'));
 384   4   =          YEAR= GET$BYTE(2);
 385   4   =          IF YEAR >= 90 THEN CALL BACK$SPACE$ERASE(9);
 387   4   =       END; /* WHILE YEAR */
 388   3   =       DO WHILE MONTH >= 13;
 389   4   =          CALL SEND$STRING$CRT(.(' MONTH: $'));
 390   4   =          MONTH = GET$BYTE(2);
 391   4   =          IF MONTH >= 13 THEN CALL BACK$SPACE$ERASE(10);
 393   4   =       END; /* WHILE MONTH */
 394   3   =       DO WHILE DAY >= 32;
```

```
395   4  =          CALL SEND$STRING$CRT(.(' DAY: $'));
396   4  =          DAY = GET$BYTE(2);
397   4  =          IF DAY >= 32 THEN CALL BACK$SPACE$ERASE(8);
399   4  =       END; /* WHILE DAY */
400   3  =       DO WHILE HOURS >= 24;
401   4  =          CALL SEND$STRING$CRT(.(' HOURS: $'));
402   4  =          HOURS = GET$BYTE(2);
403   4  =          IF HOURS >= 24 THEN CALL BACK$SPACE$ERASE(10);
405   4  =       END; /* WHILE HOURS */
406   3  =       DO WHILE MINUTES >= 60;
407   4  =          CALL SEND$STRING$CRT(.(' MINUTES: $'));
408   4  =          MINUTES = GET$BYTE(2);
409   4  =          IF MINUTES >= 60 THEN CALL BACK$SPACE$ERASE(12);
411   4  =       END; /* WHILE MINUTES */
412   3  =       DO WHILE SECONDS >= 60;
413   4  =          CALL SEND$STRING$CRT(.(' SECONDS: $'));
414   4  =          SECONDS = GET$BYTE(2);
415   4  =          IF SECONDS >= 60 THEN CALL BACK$SPACE$ERASE(12);
417   4  =       END; /* WHILE SECONDS */
418   3  =    OK = CHECK$INPUT;
419   3  =    CALL CLOCK$TIMER(2);
```

```
420   3  =    CALL CLEAR$LOW$SCREEN;
421   3  =    END; /* WHILE OK = 0 */
422   2  =    ENABLE;
             =
423   2  =    END; /* INITIATE$TIME */
             =
             =
             =    /*  END DECLARATIONS FOR INTERRUPT DRIVEN CLOCK . */



424   1       OUTPUT$STATUS$LP: PROCEDURE BYTE;

                /* TRUE IF DATA OUTPUT LINE TO LP READY */
425   2       RETURN ROR(INPUT(245),2);
426   2       END;



427   1       SEND$CHAR$LP: PROCEDURE (CHAR);
```

```
                /* SEND A CHARACTER TO THE LINE PRINTER */
 428    2       DCL CHAR BYTE;
 429    2       DO WHILE NOT OUTPUT$STATUS$LP;
 430    3        END; /* DO WHILE */
 431    2       OUTPUT(244)=CHAR;
 432    2       END;



 433    1       PCRLF: PROCEDURE;

                /* SEND CRLF TO PRINTER */
 434    2       CALL SEND$CHAR$LP(0DH);
 435    2       CALL SEND$CHAR$LP(0AH);
 436    2       END; /* PCRLF */



 437    1       SEND$STRING$LP: PROCEDURE (STRING$ADDRESS);
```

```
                /* SEND MESSAGE AT STRING$ADDRESS UNTIL '$' IS DETECTE
D */
 438   2        DCL STRING$ADDRESS ADDRESS;
 439   2        DCL TEMPCHAR BASED STRING$ADDRESS BYTE;
 440   2        DO WHILE TEMPCHAR <> '$';
 441   3           CALL SEND$CHAR$LP(TEMPCHAR);
 442   3           STRING$ADDRESS= STRING$ADDRESS + 1;
 443   3        END; /* TEMPCHAR */
 444   2        END; /* SEND$STRING$LP */



 445   1        INITIALIZE$SCREEN: PROCEDURE;

                /* THIS PROCEDURE PREPARES SCREEN FOR DISPLAY OF STATI
STICAL DATA .
              -  */
 446   2        CALL SEND$CHAR$CRT(01EH); /* MASTER */
 447   2        CALL SEND$CHAR$CRT(07H); /* RING BELL */
 448   2        CALL SEND$CHAR$CRT(02H); /* HOME */
 449   2        END;
```

```
 450   1       INITIALIZE$PRINTER: PROCEDURE;

               /* THIS PROCEDURE PREPARES PRINTER FOR PRINTING OF DAT
A . */
 451   2       CALL SET$TTY$9600;
 452   2       OUTPUT(10)=0FFH;
 453   2       CALL SEND$CHAR$LP(0CH); /* NEXT PAGE */
 454   2       CALL SEND$CHAR$LP(0DH); /* CR */
 455   2       CALL SEND$CHAR$LP(0AH); /* LF */
 456   2       END;


 457   1       CLOSE$PRINTER: PROCEDURE;

               /* THIS PROCEDURE PAGES DATA THAT WAS JUST WRITTEN TO
PRINTER. */
 458   2       CALL SEND$CHAR$LP(0CH);
 459   2       CALL SEND$CHAR$LP(0CH);
 460   2       OUTPUT(10)=000H;
 461   2       CALL SET$TTY$2400;
 462   2       END;
```

```
463   1       LIST$MENU$COMMANDS: PROCEDURE;

               /* THIS PROCEDURE DISPLAYS COMMAND OPTIONS */
464   2       PRINT$TEMP=SCREEN$PRINT;
465   2       SCREEN$PRINT=FALSE;
466   2       COMMAND$MENU=TRUE;
467   2       DO XY1=1 TO 2;
468   3           CALL CRLF;
469   3       END; /* XY1 */
470   2       CALL SEND$STRING$CRT(.
                  ('                                COMMAND OPTIONS $'));
471   2       CALL CRLF;
472   2       CALL SEND$STRING$CRT(.
                  ('                                --------------- $'));
473   2       CALL CRLF;
474   2       CALL CRLF;
475   2       CALL SEND$STRING$CRT(.
                  ('B.............: DISPLAY GENERAL DATA STATISTICS
TO CRT SCREEN
```

```
          -   .$'));
 476   2      CALL CRLF;
 477   2      CALL SEND$STRING$CRT(.
                ('G..............: DISPLAY GENERAL DATA STATISTICS
 TO LINE PRINT
          -   ER.$'));
 478   2      CALL CRLF;
 479   2      CALL SEND$STRING$CRT(.
                ('S..............: DISPLAY GENERAL DATA STATISTICS
 PER DATA RECE
          -   PTION.$'));
 480   2      CALL CRLF;
 481   2      CALL SEND$STRING$CRT(.
                ('L-F#,L-H#,L-U#..: DISPLAY CONTACT STATISTICS TO S
CREEN.$'));
 482   2      CALL CRLF;
 483   2      CALL SEND$STRING$CRT(.
                ('P-F#,P-H#,P-U#..: DISPLAY CONTACT STATISTICS TO L
INE PRINTER.$'
          -   ));
 484   2      CALL CRLF;
 485   2      CALL SEND$STRING$CRT(.
                ('W..............: DISPLAY CURRENT TIME AND DATE T
O SCREEN.$'));
 486   2      CALL CRLF;
 487   2      CALL SEND$STRING$CRT(.
```

```
                  ('T...............: RESET DATE AND TIME.$'));
 488   2       CALL CRLF;
 489   2       CALL SEND$STRING$CRT(.
                  ('R...............: DATA RECEPTION VERIFICATION TO
SCREEN.$'));
 490   2       CALL CRLF;
 491   2       CALL SEND$STRING$CRT(.
                  ('Z...............: SET STATUS OF PLASMA (1 AND 2)
AND LINE PRINT
            -   ER.$'));
 492   2       CALL CRLF;
 493   2       CALL SEND$STRING$CRT(.
                  ('M...............: DISPLAY COMMAND OPTIONS TO SCRE
EN.$'));
 494   2       CALL CRLF;
 495   2       CALL SEND$STRING$CRT(.
                  ('N...............: DISPLAY COMMAND OPTIONS TO LINE
 PRINTER.$'));
 496   2       CALL CRLF;

 497   2       END; /* LIST$MENU$COMMANDS */


 498   1       LIST$MENU$COMMANDS$LP: PROCEDURE;
```

```
                /* THIS PROCEDURE DISPLAYS COMMAND OPTIONS TO LINE PRI
NTER */
 499   2        CALL SEND$STRING$LP(.
                  ('                                  COMMAND OPTIONS $'));
 500   2        CALL PCRLF;
 501   2        CALL SEND$STRING$LP(.
                  ('                                  -------------- $'));
 502   2        CALL PCRLF;
 503   2        CALL PCRLF;
 504   2        CALL SEND$STRING$LP(.
                  ('B.............: DISPLAY GENERAL DATA STATISTICS
TO CRT SCREEN.
             -   $'));
 505   2        CALL PCRLF;
 506   2        CALL SEND$STRING$LP(.
                  ('G.............: DISPLAY GENERAL DATA STATISTICS
TO LINE PRINTE
             -   R.$'));
 507   2        CALL PCRLF;
 508   2        CALL SEND$STRING$LP(.
                  ('S.............: DISPLAY GENERAL DATA STATISTICS
PER DATA RECEP
             -   TION.$'));
 509   2        CALL PCRLF;
```

```
 510   2       CALL SEND$STRING$LP(.
                 ('L-F#,L-H#,L-U#..: DISPLAY CONTACT STATISICS TO SCR
EEN.$'));
 511   2       CALL PCRLF;
 512   2       CALL SEND$STRING$LP(.
                 ('P-F#,P-H#,P-U#..: DISPLAY CONTACT STATISTICS TO LI
NE PRINTER.$')
             -   );
 513   2       CALL PCRLF;
 514   2       CALL SEND$STRING$LP(.
                 ('W..............: DISPLAY CURRENT TIME AND DATE TO
 SCREEN.$'));
 515   2       CALL PCRLF;
 516   2       CALL SEND$STRING$LP(.
                 ('T..............: RESET DATE AND TIME.$'));
 517   2       CALL PCRLF;
 518   2       CALL SEND$STRING$LP(.
                 ('R..............: DATA RECEPTION VERIFICATION TO S
CREEN.$'));
 519   2       CALL PCRLF;
 520   2       CALL SEND$STRING$LP(.
                 ('Z..............: SET STATUS OF PLASMA (1AND 2) AN
D LINE PRINTER
             -   .$'));
 521   2       CALL PCRLF;
 522   2       CALL SEND$STRING$LP(.
```

```
                 ('M...............: DISPLAY COMMAND OPTIONS TO SCREE
N.$'));
 523   2       CALL PCRLF;
 524   2       CALL SEND$STRING$LP(.
                 ('N...............: DISPLAY COMMAND OPTIONS TO LINE
PRINTER.$'));
 525   2       CALL PCRLF;

 526   2       END; /* LIST$MENU$COMMANDS$LP */



 527   1       ORIG$STRUCTURE$WRITE: PROCEDURE;
               /* THIS PROCEDURE WRITES THE ORIGINAL STRUCTURE CREATE
D AND
                     STORED BY THE MDS MICRO . */

 528   2       DCL (WI,ZK,ZJ) ADDRESS;
 529   2       CALL OPEN(.AFT$IN,.STR$OR$NM,2,0,.OPEN$STATUS);
 530   2       WI=128;
 531   2       ZK=0;
 532   2       DO ZJ = 1 TO 5;
 533   3          IF ZJ = 5 THEN WI = 121;
 535   3          CALL WRITE(AFT$IN,.SHIP$PLOT(0).LAT(0)+ZK,WI,.WRITE
$STATUS);
```

```
 536   3          ZK = ZK + 128;
 537   3       END; /* DO ZJ */
 538   2       CALL CLOSE(AFT$IN,.CLOSE$STATUS);
 539   2       END; /* ORIG$STRUCTURE$WRITE */



 540   1       NEW$STRUCTURE$WRITE: PROCEDURE;

               /* THIS PROCEDURE WRITES THE MOST RECENTLY CREATED STR
UCTURE
                   CRAETED FROM THE PDP BUFFER. */
 541   2       DCL (NI,NK,NJ) ADDRESS;
 542   2       CALL OPEN(.AFT$IN,.STR$NM,2,0,.OPEN$STATUS);
 543   2       NI=128;
 544   2       NK=0;
 545   2       DO NJ = 1 TO 5;
 546   3          IF NJ = 5 THEN NI = 121;
 548   3          CALL WRITE(AFT$IN,.SHIP$PLOT(0).LAT(0)+NK,NI,.WRITE
$STATUS);
 549   3          NK=NK+128;
 550   3       END; /* DO NJ */
 551   2       CALL CLOSE(AFT$IN,.CLOSE$STATUS);
```

```
 552   2       END; /* NEW$STRUCTURE$WRITE */



 553   1       ORIG$PDP$WRITE: PROCEDURE;

               /* THIS PROCEDURE WRITES THE MOST RECENT RECEIVED BYTE
INFORMATION
                   IN THE PDP BUFFER (MDS) FROM THE PDP-MINI. */
 554   2       DCL (PI,PJ,PK) ADDRESS;
 555   2       CALL OPEN(.AFT$IN,.PDP$NM,2,0,.OPEN$STATUS);
 556   2       PI=128;
 557   2       PK=0;
 558   2       DO PJ = 1 TO 5;
 559   3          IF PJ = 5 THEN PI = 121;
 561   3          CALL WRITE(AFT$IN,.PDP$BUFFER(3)+PK,PI,.WRITE$STATU
S);
 562   3          PK=PK+128;
 563   3       END; /* DO PJ */
 564   2       CALL CLOSE(AFT$IN,.CLOSE$STATUS);
 565   2       END; /* ORIG$PDP$WRITE */
```

```
                /* THIS ARRAY RECEIVES BYTE DATA IN THE MDS-MICRO FROM
                    THE PDP-MINI. */
 566   1        DCL PDP$BUFFER (2000) BYTE EXTERNAL;

 567   1        PDP$STRUCTURE: PROCEDURE EXTERNAL;
                /* THIS PROCEDURE INTERFACES THE MDS-MICRO AND PDP-MIN
I */
 568   2        END;

 569   1        MAKE$ADDRESS: PROCEDURE (X) ADDRESS;
                /* THIS PROCEDURE CONVERTS TWO BYTE VALUE TO AN ADDRES
S VALUE */
 570   2        DCL X ADDRESS;
 571   2        DCL C ADDRESS;
 572   2        C = PDP$BUFFER(X+1);
```

```
 573   2      C = (SHL(C,8)+PDP$BUFFER(X));
 574   2      IF C >= 04000H THEN
 575   2         DO;
 576   3         C = C AND 03F7FH;
 577   3         C = C OR 0080H;
 578   3      END; /* IF C */
 579   2      RETURN C;
 580   2      END; /* MAKE$ADDRESS */



 581   1      LOCATE$STRUCTURE$PDP: PROCEDURE;

                /* THIS PROCEDURE LOCATES PDP BUFFER BYTE VALUES TO AP
PROPRIATE
                     SHIP PLOT STRUCTURE BYTE AND ADDRESS VALUES */
 582   2      DCL (PDP$BUF$OFFSET,N,I,K,J,L) ADDRESS;
 583   2      PDP$BUF$OFFSET=3;
 584   2      DO I = 0 TO 2;
 585   3         J=(I*211);
 586   3         SHIP$PLOT(I).COUNT = PDP$BUFFER(J+210+PDP$BUF$OFFSE
T);
 587   3         DO K = 0 TO 9;
```

```
 588   4          N=K+J+PDP$BUF$OFFSET;
 589   4          L=(K*2)+J+PDP$BUF$OFFSET;
 590   4          SHIP$PLOT(I).LAT(K) = MAKE$ADDRESS(0+L);
 591   4          SHIP$PLOT(I).LONG(K) = MAKE$ADDRESS(20+L);
 592   4          SHIP$PLOT(I).COURSE(K) = MAKE$ADDRESS(40+L);
 593   4          SHIP$PLOT(I).SPEED(K) = PDP$BUFFER(60+N);
 594   4          SHIP$PLOT(I).X$BOW(K) = MAKE$ADDRESS(70+L);
 595   4          SHIP$PLOT(I).Y$BOW(K) = MAKE$ADDRESS(90+L);
 596   4          SHIP$PLOT(I).QUADRANT(K) = PDP$BUFFER(110+N);
 597   4          SHIP$PLOT(I).RANGE(K) = MAKE$ADDRESS(120+L);
 598   4          SHIP$PLOT(I).BEARING(K) = MAKE$ADDRESS(140+L);
 599   4          SHIP$PLOT(I).COLLISION$FLAG(K) = PDP$BUFFER(160+N)
;
 600   4          SHIP$PLOT(I).CPA$TIME(K) = MAKE$ADDRESS(170+L);
 601   4          SHIP$PLOT(I).CPA$DISTANCE(K) = MAKE$ADDRESS(190+L)
;
 602   4        END; /* DO K */
 603   3      END;    /* DO I */

 604   2      END; /* LOCATE$STRUCTURE$PDP */


 605   1      INIT$CHECK: PROCEDURE;
```

```
606   2       DCL (D,E) BYTE;
607   2       DO E=0 TO 2;
608   3        SHIP$PLOT(E).COUNT='L';
609   3         DO D=0 TO 9;
610   4           SHIP$PLOT(E).LAT(D)='10';
611   4           SHIP$PLOT(E).LONG(D)='32';
612   4           SHIP$PLOT(E).COURSE(D)='54';
613   4           SHIP$PLOT(E).SPEED(D)='6';
614   4           SHIP$PLOT(E).X$BOW(D)='87';
615   4           SHIP$PLOT(E).Y$BOW(D)='A9';
616   4           SHIP$PLOT(E).QUADRANT(D)='B';
617   4           SHIP$PLOT(E).RANGE(D)='DC';
618   4           SHIP$PLOT(E).BEARING(D)='FE';
619   4           SHIP$PLOT(E).COLLISION$FLAG(D)='G';
620   4           SHIP$PLOT(E).CPA$TIME(D)='HI';
621   4           SHIP$PLOT(E).CPA$DISTANCE(D)='KJ';
622   4         END;
623   3        END;
624   2      END;
```

```
 625   1       INT$3:PROCEDURE INTERRUPT 3;
 626   2       CALL OFF$CRT$KEYBOARD;
 627   2       Z =INPUT(244) AND 07FH;
 628   2       IF (Z = '2') THEN
 629   2          DO;
 630   3          IF STRUCTURE$COUNT > 0 THEN
 631   3          CALL BACKUPS (STRUCTURE$COUNT);
 632   3          CALL SET$LOW$HOME;
 633   3          CALL PDP$STRUCTURE;
 634   3           CALL LOCATE$STRUCTURE$PDP;
 635   3          IF (PLASMA$SWITCH=0) THEN
 636   3            DO;
 637   4            CALL INITIALIZE$PRINTER;
 638   4            CALL CONSOL(.(':CI:$'),.(':TO:$'),.CONSOL$STATUS)
;
 639   4            CALL LOAD$TIME;
 640   4            CALL WRITE$BIGPICTURE$LP;
 641   4            CALL CONSOL(.(':CI:$'),.(':VO:$'),.CONSOL$STATUS)
;
 642   4            CALL CLOSE$PRINTER;
 643   4            END; /* P=0 */
 644   3          IF ((PLASMA$SWITCH = 2) OR (PLASMA$SWITCH = 3)) THE
N
```

```
 645   3          DO;
 646   4          CALL SEND$GRID$PLASMA$2;
 647   4          IF PLASMA$SWITCH = 3 THEN CALL DRAW$SHIP$2(0);
 649   4          ELSE CALL DRAW$SHIP$2(1);
 650   4          END; /* IF P=2 OR P=3 */
 651   3          IF ((PLASMA$SWITCH=1) OR (PLASMA$SWITCH=3)) THEN
 652   3          DO;
 653   4          CALL SEND$GRID$PLASMA;
 654   4          CALL DRAW$SHIP(1);
 655   4          END; /* IF P=1 OR P=3 */
 656   3          END;
               ELSE
 657   2          DO;
 658   3          DO WHILE (Z <> '%');
 659   4              DO WHILE NOT INPUT$STATUS$PDP;
 660   5              END;
 661   4              Z = READ$CHAR$PDP;
 662   4          END;
 663   3          CALL PRINT$TO$CRT(.(' **** SKIPPED/MISSED INTERRUPT
! ****$'));
 664   3          END;
 665   2        XY=2;
```

```
666   2       IF SCREEN$PRINT=TRUE THEN
667   2       DO;
668   3       CALL INITIALIZE$LOAD$PICTURE(XY);
669   3       CALL SEND$CHAR$CRT(07H); /* BELL */
670   3       CALL SEND$CHAR$CRT(02H); /* HOME */
671   3       CALL CLEAR$NEXT$LINES(19);
672   3       CALL SEND$CHAR$CRT(02H); /* HOME */
673   3       CALL LOAD$TIME;
674   3       CALL WRITE$BIGPICTURE;
675   3       CALL CLEAR$LOW$SCREEN;
676   3       END;
677   2       ELSE IF RECEIVE$PRINT THEN
678   2                 DO;
679   3                   CALL CLOCK$TIMER(4);
680   3                   CALL CLEAR$LOW$SCREEN;
681   3                 END; /* RECEIVE$PRINT */
                IF COMMAND$MENU=TRUE THEN
683   2       DO;
684   3       CALL CLEAR$LOW$SCREEN;
685   3       SCREEN$PRINT=PRINT$TEMP;
686   3       END; /* IF COMMAND$MENU=TRUE */
```

```
687   2       COMMAND$MENU=FALSE;
688   2       OUTPUT(243)=0FFH;
689   2       OUTPUT(253)=020H;
690   2       IF STRUCTURE$COUNT < 4 THEN
691   2          STRUCTURE$COUNT = STRUCTURE$COUNT + 1;
692   2       CALL SET$LOW$HOME;
693   2       CALL SEND$STRING$CRT(.('DATA UPDATED : READY . $'));
694   2       CALL ON$CRT$KEYBOARD;
695   2       DO XY1=1 TO 5;
696   3          CALL TIME(250);
697   3       END; /* XY1=1 TO 5 */
698   2       CALL ON$CRT$KEYBOARD;
699   2       ENABLE;
700   2       END; /* INTERRUPT THREE */



701   1       INT$6: PROCEDURE INTERRUPT 6;

                /* THIS PROCEDURE SERVICE THE INTERRUPTS CAUSED BY
                   THE PLASMA(DEVICE ONE) TOUCH-PANEL DEVICE.   */
```

```
 702   2      CALL SET$LOW$HOME;
 703   2      CALL SERVICE$SIX;
 704   2      OUTPUT(243)=0FFH;
 705   2      OUTPUT(253)=020H;
 706   2      ENABLE;
 707   2      END; /* INTERRUPT PROCEDURE INT$6 */


 708   1      DISABLE;
 709   1      CALL SET$TTY$2400;
 710   1      MILI$SEC,DUMMY$SEC=00;
 711   1      CALL INITIALIZE$GRAPHICS;
 712   1      PLASMA$SWITCH = 3;
 713   1      PRINT$TEMP=TRUE;
 714   1      COMMAND$MENU = FALSE;
 715   1      RECEIVE$PRINT=TRUE;
 716   1      SCREEN$PRINT=TRUE;
 717   1      ERASE$COUNT=0;
 718   1      XY=3165;
 719   1      CALL SET$STRUCTURE$ZEROES(.SHIP$PLOT(0).LAT(0),XY);
 720   1      STRUCTURE$COUNT=0;
```

```
721   1       OUTPUT(253)=12H;
722   1       OUTPUT(252)=0;
723   1       OUTPUT(252)=0B0H;
724   1       OUTPUT(243)=0FFH;
725   1       LOC$18H=0C3H;
726   1       LOC$19H=.INT$3;
727   1       LOC$30H=0C3H;
728   1       LOC$31H=.INT$6;
729   1       LOC$38 =0C3H;
730   1       LOC$39 =.CLOCK;
731   1       CALL MOVE(3,038H,008H);

732   1       CALL SEND$CHAR$CRT(018H);
              /* OUT OF 'ROLL MODE' */
733   1       CALL SEND$CHAR$CRT(01EH); /* MASTER CLEAR */
734   1       CALL INITIALIZE$M0$ARRAY;
735   1       ENABLE;
736   1       OUTPUT(0FFH) = 00H;
737   1       CALL SET$LOW$HOME;
738   1       CALL INITIATE$TIME;
739   1       DO WHILE 1;
```

```
 740   2       IF (ROR (INPUT(247),1)) THEN
 741   2         DO;
 742   3          TEST$CHAR=INPUT(246) AND 07FH;
 743   3          IF TEST$CHAR = 'L' THEN
 744   3             DO;
 745   4       DISABLE;
 746   4             CALL SET$LOW$HOME;
 747   4             CALL SEND$STRING$CRT(.
                      ('CONTACT STATISTICS TO SCREEN (Y/N) $'));
 748   4             IF CHECK$YES$NO THEN
 749   4              DO;
 750   5              CALL CLOCK$TIMER(2);
 751   5              CALL CLEAR$LOW$SCREEN;
 752   5             OK=0;
 753   5             DO WHILE OK=0;
 754   6             CALL SET$LOW$HOME;
 755   6             CALL SEND$STRING$CRT(.('CONTACT STATISTICS TO SC
REEN. $'));
 756   6             CALL CRLF;
 757   6             CALL SEND$STRING$CRT(.('ENTER CONTACT ID:F# OR H
# OR U# . $'))
                        ;
 758   6             DO WHILE NOT (ROR(INPUT(247),1));
```

```
 759   7            END;
 760   6            IDA= INPUT(246) AND 07FH;
 761   6            DO WHILE
                      ((IDA<>'H') AND (IDA<>'h') AND (IDA<>'U') AND
                       (IDA<>'u') AND (IDA<>'F') AND (IDA<>'f'));
 762   7              CALL SEND$CHAR$CRT(07H);
 763   7              CALL SEND$STRING$CRT(.(' INPUT DATA INCORRECT,
ENTER CORRECT
          -   DATA.$'));
 764   7              DO WHILE NOT(ROR(INPUT(247),1));
 765   8              END;
 766   7              IDA=INPUT(246) AND 07FH;
 767   7              CALL BACK$SPACE$ERASE(41);
 768   7              END; /* DO WHILE */
 769   6              CALL SEND$CHAR$CRT(IDA);
 770   6              IF IDA='F' OR IDA= 'f' THEN XY=0;
 772   6              IF IDA='H' OR IDA= 'h' THEN XY=1;
 774   6              IF IDA='U' OR IDA= 'u' THEN XY=2;
 776   6            DO WHILE NOT(ROR(INPUT(247),1));
 777   7            END;
 778   6            IDB = INPUT(246) AND 07FH;
 779   6            DO WHILE((IDB-'0') > (SHIP$PLOT(XY).COUNT-1) OR
```

```
                              (SHIP$PLOT(XY).COUNT =  0 ));
 780   7              CALL SEND$CHAR$CRT(07H);
 781   7              CALL SEND$STRING$CRT(.(' INPUT DATA INCORRECT,
ENTER CORRECT
          -   DATA.$'));
 782   7              DO WHILE NOT(ROR(INPUT(247),1));
 783   8              END;
 784   7              IDB=INPUT(246) AND 07FH;
 785   7              CALL BACK$SPACE$ERASE(41);
 786   7              END; /* DO WHILE */
 787   6              CALL SEND$CHAR$CRT(IDB);
 788   6            OK=CHECK$INPUT;
 789   6            CALL CLOCK$TIMER(2);
 790   6            IF OK=0 THEN CALL CLEAR$LOW$SCREEN;
 792   6            END; /* WHILE OK=0 */
 793   5            CALL LOAD$DATA$LITTLEPICTURE(IDA,IDB);
 794   5            CALL INITIALIZE$SCREEN;
 795   5            CALL LOAD$TIME;
 796   5            CALL WRITE$LITTLEPICTURE;
 797   5            CALL CLEAR$NEXT$LINES(5);
 798   5            CALL CLEAR$LOW$SCREEN;
 799   5            END; /* IF CHECK$YES$NO */
```

```
                    ELSE
 800   4                 DO;
 801   5                 CALL CLOCK$TIMER(2);
 802   5                 CALL CLEAR$LOW$SCREEN;
 803   5                END; /* ELSE */
 804   4          ENABLE;
 805   4             END; /* IF TEST$CHAR = 'L' */
                    ELSE
 806   3                IF TEST$CHAR = 'P' THEN
 807   3                   DO;
 808   4                   DISABLE;
 809   4                CALL SET$LOW$HOME;
 810   4                 CALL SEND$STRING$CRT(.
                            ('CONTACT STATISTICS TO LINE PRINTER (Y/N) $')
);
 811   4                 IF CHECK$YES$NO THEN
 812   4                  DO;
 813   5                  CALL CLOCK$TIMER(2);
 814   5                  CALL CLEAR$LOW$SCREEN;
 815   5                 OK=0;
 816   5                 DO WHILE OK=0;
 817   6                   CALL SET$LOW$HOME;
```

```
 818   6              CALL SEND$STRING$CRT(.
                          ('CONTACT STATISTICS TO LINE PRINTER. $')
);
 819   6              CALL CRLF;
 820   6              CALL SEND$STRING$CRT(.('ENTER CONTACT ID:F# O
R H# OR U# . $
           -    '));
 821   6              DO WHILE NOT (ROR(INPUT(247),1));
 822   7              END;
 823   6              IDA=INPUT(246) AND 07FH;
 824   6             DO WHILE
                         ((IDA<>'H') AND (IDA<>'h') AND (IDA<>'U') A
ND
                          (IDA<>'u') AND (IDA<>'F') AND (IDA<>'f'));
 825   7              CALL SEND$CHAR$CRT(07H);
 826   7              CALL SEND$STRING$CRT(.(' INPUT DATA INCORRECT
,ENTER CORRECT
           -    DATA.$'));
 827   7              DO WHILE NOT(ROR(INPUT(247),1));
 828   8              END;
 829   7              IDA=INPUT(246) AND 07FH;
 830   7              CALL BACK$SPACE$ERASE(41);
 831   7              END; /* DO WHILE */
 832   6              CALL SEND$CHAR$CRT(IDA);
 833   6              IF IDA ='F' OR IDA ='f' THEN XY=0;
```

```
 835   6              IF IDA ='H' OR IDA ='h' THEN XY=1;
 837   6              IF IDA ='U' OR IDA ='u' THEN XY=2;
 839   6              DO WHILE NOT(ROR(INPUT(247),1));
 840   7              END;
 841   6              IDB=INPUT(246) AND 07FH;
 842   6            DO WHILE ((IDB-'0') > (SHIP$PLOT(XY).COUNT-1) O
R
                            (SHIP$PLOT(XY).COUNT = 0 ));
 843   7              CALL SEND$CHAR$CRT(07H);
 844   7              CALL SEND$STRING$CRT(.(' INPUT DATA INCORRECT
,ENTER CORRECT
          -    DATA.$'));
 845   7              DO WHILE NOT (ROR(INPUT(247),1));
 846   8              END;
 847   7              IDB=INPUT(246) AND 07FH;
 848   7              CALL BACK$SPACE$ERASE(41);
 849   7              END; /* DO WHILE */
 850   6              CALL SEND$CHAR$CRT(IDB);
 851   6              OK=CHECK$INPUT;
 852   6              CALL CLOCK$TIMER(2);
 853   6              IF OK=0 THEN CALL CLEAR$LOW$SCREEN;
 855   6            END; /* WHILE OK=0 */
 856   5              CALL LOAD$DATA$LITTLEPICTURE(IDA,IDB);
```

```
 857   5              CALL INITIALIZE$PRINTER;
 858   5              CALL CONSOL(.(':CI:$'),.(':TO:$'),.CONSOL$STA
TUS);
 859   5              CALL LOAD$TIME;
 860   5              CALL WRITE$LITTLEPICTURE$LP;
 861   5              CALL CONSOL(.(':CI:$'),.(':VO:$'),.CONSOL$STA
TUS);
 862   5              CALL CLOSE$PRINTER;
 863   5              CALL CLEAR$LOW$SCREEN;
 864   5              END; /* IF CHECK$YES$NO */
                      ELSE
 865   4               DO;
 866   5               CALL CLOCK$TIMER(2);
 867   5               CALL CLEAR$LOW$SCREEN;
 868   5              END; /* ELSE */
 869   4             ENABLE;
 870   4              END; /* IF TEST$CHAR = 'P' */
                    ELSE
 871   3              IF TEST$CHAR = 'G' THEN
 872   3                 DO;
 873   4                 DISABLE;
 874   4                 CALL SET$LOW$HOME;
 875   4                 CALL SEND$STRING$CRT(.
```

```
                        ('GENERAL DATA STATISTICS TO PRINTER (Y/N)
 $'));
 876   4                 IF CHECK$YES$NO THEN
 877   4                    DO;
 878   5                    CALL INITIALIZE$PRINTER;
 879   5                    CALL CONSOL(.(':CI:$'),.(':TO:$'),.CONSOL$
STATUS);
 880   5                    CALL LOAD$TIME;
 881   5                    CALL WRITE$BIGPICTURE$LP;
 882   5                    CALL CONSOL(.(':CI:$'),.(':VO:$'),.CONSOL$
STATUS);
 883   5                    CALL CLOSE$PRINTER;
 884   5                    END; /* IF CHECK$INPUT */
 885   4                         ELSE CALL CLOCK$TIMER (2);
 886   4                         CALL CLEAR$LOW$SCREEN;
 887   4                  ENABLE;
 888   4                    END;
                         ELSE
 889   3                    IF TEST$CHAR='B' THEN
 890   3                       DO;
 891   4                     DISABLE;
 892   4                       CALL SET$LOW$HOME;
 893   4                       CALL SEND$STRING$CRT(.
                                 ('GENERAL DATA STATISTICS TO SCREE
EN (Y/N) $'));
```

```
 894   4                    IF CHECK$YES$NO THEN
 895   4                       DO;
 896   5                    CALL CLOCK$TIMER(2);
 897   5                    CALL INITIALIZE$SCREEN;
 898   5                    CALL LOAD$TIME;
 899   5                    CALL WRITE$BIGPICTURE;
 900   5                    END; /* IF CHECK$INPUT */
 901   4                    ELSE CALL CLOCK$TIMER(2);
 902   4                    CALL CLEAR$LOW$SCREEN;
 903   4                  ENABLE;
 904   4                    END;
                         ELSE
 905   3                     IF TEST$CHAR='T' THEN
 906   3                        DO;
 907   4                      DISABLE;
 908   4                        CALL SET$LOW$HOME;
 909   4                        CALL SEND$STRING$CRT(.
                                    ('ENTER NEW DATE/TIME (Y/N) $'))
;
 910   4                        IF CHECK$YES$NO THEN
 911   4                         DO;
 912   5                           CALL CLOCK$TIMER(2);
```

```
 913   5                          CALL CLEAR$LOW$SCREEN;
 914   5                        CALL SET$LOW$HOME;
 915   5                        CALL INITIATE$TIME;
 916   5                        END; /* IF CHECK$INPUT */
 917   4                        ELSE CALL CLOCK$TIMER(2);
 918   4                        CALL CLEAR$LOW$SCREEN;
 919   4                      ENABLE;
 920   4                        END;
                         ELSE
 921   3                      IF TEST$CHAR='W' THEN
 922   3                      DO;
 923   4                      DISABLE;
 924   4                        CALL SET$LOW$HOME;
 925   4                        CALL LOAD$TIME;
 926   4                        CALL WRITE(0,.M0(0),73,.WRITE$STATUS)
;
 927   4                            DO XY = 1 TO 180;
 928   5                              CALL TIME(250);
 929   5                            END; /* DO XY */
 930   4                        CALL CLEAR$LOW$SCREEN;
 931   4                      ENABLE;
 932   4                        END;
```

```
                        ELSE
 933   3                      IF TEST$CHAR='R' THEN
 934   3                         DO;
 935   4                        DISABLE;
 936   4                          CALL SET$LOW$HOME;
 937   4                          CALL SEND$STRING$CRT(.('VERIFY DATA
RECEPTION.(Y/N
           -    )$'));
 938   4                          IF CHECK$YES$NO THEN RECEIVE$PRINT=T
RUE;
 940   4                             ELSE RECEIVE$PRINT=FALSE;
 941   4                          CALL CLOCK$TIMER(2);
 942   4                          CALL CLEAR$LOW$SCREEN;
 943   4                     ENABLE;
 944   4                         END; /* 'R' */
                            ELSE
 945   3                         IF TEST$CHAR='S' THEN
 946   3                          DO;
 947   4                          DISABLE;
 948   4                         CALL SET$LOW$HOME;
 949   4                          CALL SEND$STRING$CRT(.
                                ('PRINT GENERAL DATA STATISTICS PER D
ATA RECEPTION
           -    (Y/N) $'));
```

```
 950   4                        IF CHECK$YES$NO THEN SCREEN$PRINT=TR
UE;
 952   4                        ELSE SCREEN$PRINT=FALSE;
 953   4                        CALL CLOCK$TIMER(2);
 954   4                        CALL CLEAR$LOW$SCREEN;
 955   4                        ENABLE;
 956   4                        END ; /* IF 'S' */
                               ELSE
 957   3                           IF TEST$CHAR = 'Z' THEN
 958   3                            DO;
 959   4                            DISABLE;
 960   4                            CALL SET$LOW$HOME;
 961   4                            CALL SEND$STRING$CRT(.
                                     ('REASSIGN PLASMA DEVICES (Y/N)
$'));
 962   4                            IF CHECK$YES$NO THEN
 963   4                             DO;
 964   5                             CALL CLOCK$TIMER(2);
 965   5                             OK = 0;
 966   5                             DO WHILE OK = 0;
 967   6                             CALL CLEAR$LOW$SCREEN;
 968   6                             CALL SET$LOW$HOME;
 969   6                             CALL SEND$STRING$CRT(.
```

```
                                        ('OUTPUT GRAPHIC DISPLAY TO SWI
TCH (#) $'));
 970   6                               CALL CRLF;
 971   6                               CALL SEND$STRING$CRT(.('(0)LP ON
LY  $'));
 972   6                               CALL SEND$STRING$CRT(.
                                        (' (1)PLASMA.ONE   (2)PLASMA.TW
O   (3)PLASMA.
           -   ONE$'));
 973   6                              CALL SEND$STRING$CRT(.(' AND PLAS
MA.TWO  $'));
 974   6                               CALL CRLF;
 975   6                               CALL SEND$STRING$CRT(.
                                        ('INPUT SWITCH NUMBER: 0,1,2 OR
 3. $'));
 976   6                               XY1 = READ$CHAR$CRT;
 977   6                               CALL SEND$CHAR$CRT(XY1);
 978   6                               DO WHILE ((XY1 < '0') OR (XY1 >
'3'));
 979   7                                CALL SEND$STRING$CRT(.
                                         (' INPUT DATA INCORRECT,ENTER
DATA AGAIN.$')
           -   );
 980   7                                XY1 = READ$CHAR$CRT;
 981   7                                CALL BACK$SPACE$ERASE(40);
 982   7                                CALL SEND$CHAR$CRT(XY1);
 983   7                               END; /* WHILE 1<X>3 */
 984   6                               OK = CHECK$INPUT;
```

```
 985   6                          IF OK THEN PLASMA$SWITCH = (XY1
- '0');
 987   6                             END; /* WHILE OK */
 988   5                          END; /* IF CHECK$YES$NO */
 989   4                          CALL CLOCK$TIMER(2);
 990   4                          CALL CLEAR$LOW$SCREEN;
 991   4                          ENABLE;
 992   4                       END; /* IF TEST$CHAR = 'Z' */
                               ELSE
 993   3                       IF TEST$CHAR = 'M' THEN
 994   3                          DO;
 995   4                          DISABLE;
 996   4                          CALL SET$LOW$HOME;
 997   4                          CALL SEND$STRING$CRT(.
                                   ('LIST COMMAND OPTIONS: (Y/N) $'))
;
 998   4                          IF CHECK$YES$NO THEN
 999   4                           DO;
1000   5                           CALL CLOCK$TIMER(2);
1001   5                           CALL INITIALIZE$SCREEN;
1002   5                           CALL LIST$MENU$COMMANDS;
1003   5                           END; /* IF CHECK$YES$NO */
                                  ELSE
```

```
1004   4                    DO;
1005   5                    CALL CLOCK$TIMER(2);
1006   5                    CALL CLEAR$LOW$SCREEN;
1007   5                    END; /* ELSE */
1008   4                   ENABLE;
1009   4                  END; /* IF 'M' */
                           ELSE
1010   3                    IF TEST$CHAR = 'N' THEN
1011   3                     DO;
1012   4                     DISABLE;
1013   4                     CALL SET$LOW$HOME;
1014   4                     CALL SEND$STRING$CRT(.
                              ('LIST COMMAND OPTIONS TO LINE P
RINTER (Y/N) $
                      -   '));
1015   4                     IF CHECK$YES$NO THEN
1016   4                      DO;
1017   5                      CALL CLOCK$TIMER(2);
1018   5                      CALL INITIALIZE$PRINTER;
1019   5                      CALL CONSOL(.(':CI:$'),.(':TO:$'
),.CONSOL$STAT
                      -   US);
1020   5                      DO XY1 = 1 TO 15;
```

```
1021   6                          CALL PCRLF;
1022   6                         END;
1023   5                         CALL LOAD$TIME;
1024   5                         CALL WRITE(0,.M0(0),73,.WRITE$ST
ATUS);
1025   5                         DO XY1 = 1 TO 5;
1026   6                          CALL PCRLF;
1027   6                         END;
1028   5                         CALL LIST$MENU$COMMANDS$LP;
1029   5                         CALL CONSOL(.(':CI:$'),.(':VO:$'
),.CONSOL$STAT
                 -   US);
1030   5                         CALL CLOSE$PRINTER;
1031   5                         CALL CLEAR$LOW$SCREEN;
1032   5                        END; /* IF CHECK$YES$NO */
                                 ELSE
1033   4                         DO;
1034   5                         CALL CLOCK$TIMER(2);
1035   5                         CALL CLEAR$LOW$SCREEN;
1036   5                        END; /* ELSE */
1037   4                        ENABLE;
1038   4                       END; /* IF 'N' */
                    END; /* IF ROR INPUT(247) */
```

```
1040   2       END;
1041   1       END; /* SYSTEM MODULE */


MODULE INFORMATION:

     CODE AREA SIZE     = 1FF8H   8184D
     VARIABLE AREA SIZE = 016AH    362D
     MAXIMUM STACK SIZE = 0010H     16D
     1499 LINES READ
     0 PROGRAM ERROR(S)

END OF PL/M-80 COMPILATION
```

```
ISIS-II PL/M-80 V3.1 COMPILATION OF MODULE SCREENMODULE
NO OBJECT MODULE REQUESTED
COMPILER INVOKED BY:  PLM80 :F1:SCREEN.MOD NOOBJECT PAGEWIDTH(82) PA
GELENGTH(24) D
                     -ATE(MAY 1979) TITLE('MODULE SCREEN.MOD')



   1           SCREEN$MODULE:
               DO;
   2   1       DECLARE LIT LITERALLY 'LITERALLY';
   3   1       DECLARE DCL LIT 'DECLARE';

   4   1       DCL (IDA,IDB,TEST$CHAR) BYTE;
   5   1       DCL XY ADDRESS;
   6   1       DCL ERASE$COUNT ADDRESS PUBLIC;
   7   1       DCL CONVERTED$BYTE$NUMBER (5) BYTE PUBLIC ;
   8   1       DCL WRITE$STATUS ADDRESS;

               /* EXTENALS FOR TIME PARAMETERS */
   9   1       DCL (MILI$SEC,DUMMY$SEC,SECONDS,MINUTES,HOURS,DAY,MONT
H,YEAR,SEC$TIM
```

```
            -   E)
                    BYTE EXTERNAL;
  10   1       DCL TIME$STEP ADDRESS EXTERNAL;
  11   1       DCL TIME$BUFFER(6) BYTE EXTERNAL;



                $NOLIST

 218   1       DCL L0 (*) BYTE INITIAL
                (´| CONTACT|QUADRANT| STATUS |  TYPE  | COURSE |  SPEE
D | BEARING|
            -   RANGE |
                ´);
 219   1       DCL L1 (*) BYTE INITIAL
                 (´|--------|--------|--------|--------|--------|-----
---|--------|-
            -   -------|
                ´);
 220   1       DCL L2 (*) BYTE INITIAL
                (´|        |        |        |        |     DG |    KT
S |     DG |
            -       YD|
                ´);
```

```
 221   1       DCL L3 (*) BYTE INITIAL
                ('¦         ¦         ¦         ¦         ¦      DG ¦     KT
S ¦      DG ¦
                -       YD¦
                ');
 222   1       DCL L4 (*) BYTE INITIAL
                ('¦         ¦         ¦         ¦         ¦      DG ¦     KT
S ¦      DG ¦
                -       YD¦
                ');
 223   1       DCL L5 (*) BYTE INITIAL
                ('¦         ¦         ¦         ¦         ¦      DG ¦     KT
S ¦      DG ¦
                -       YD¦
                ');
 224   1       DCL L6 (*) BYTE INITIAL
                ('¦         ¦         ¦         ¦         ¦      DG ¦     KT
S ¦      DG ¦
                -       YD¦
                ');
 225   1       DCL L7 (*) BYTE INITIAL
                ('¦         ¦         ¦         ¦         ¦      DG ¦     KT
S ¦      DG ¦
                -       YD¦
                ');
 226   1       DCL L8 (*) BYTE INITIAL
```

```
                (´¦        ¦        ¦        ¦        ¦     DG ¦    KT
S ¦     DG ¦
                -       YD¦
                ´);
 227   1        DCL L9 (*) BYTE INITIAL
                (´¦        ¦        ¦        ¦        ¦     DG ¦    KT
S ¦     DG ¦
                -       YD¦
                ´);
 228   1        DCL L1Ø (*) BYTE INITIAL
                (´¦        ¦        ¦        ¦        ¦     DG ¦    KT
S ¦     DG ¦
                -       YD¦
                ´);
 229   1        DCL L11 (*) BYTE INITIAL
                (´¦        ¦        ¦        ¦        ¦     DG ¦    KT
S ¦     DG ¦
                -       YD¦
                ´);
 230   1        DCL L12 (*) BYTE INITIAL
                (´¦        ¦        ¦        ¦        ¦     DG ¦    KT
S ¦     DG ¦
                -       YD¦
                ´);
 231   1        DCL L13 (*) BYTE INITIAL
                (´¦        ¦        ¦        ¦        ¦     DG ¦    KT
S ¦     DG ¦
```

```
                -       YD|
                ');
 232   1        DCL L14 (*) BYTE INITIAL
                ('|        |        |        |        |     DG |    KT
S |     DG |
                -       YD|
                ');
 233   1        DCL L15 (*) BYTE INITIAL
                ('|        |        |        |        |     DG |    KT
S |     DG |
                -       YD|
                ');
 234   1        DCL L16 (*) BYTE INITIAL
                ('|        |        |        |        |     DG |    KT
S |     DG |
                -       YD|
                ');
 235   1        DCL L17 (*) BYTE INITIAL
                ('|--------|--------|--------|--------|--------|------
--|--------|--
                -   ------|
                ');
```

```
 236   1       DCL M0 (73) BYTE PUBLIC;
 237   1       DCL M1 (*) BYTE INITIAL
                 ('¦          CONTACT #    STATISTICS ¦     OWNSHIP STAT
ISTICS
             -          ¦
                 ');
 238   1       DCL M2 (*) BYTE INITIAL
                 ('¦--------------------------------¦----------------
--------------
             -   ------¦
                 ');
 239   1       DCL M3 (*) BYTE INITIAL
                 ('¦  COURSE----------:        DGS    ¦       COURSE----
-----:
             -   DGS    ¦
                 ');
 240   1       DCL M4 (*) BYTE INITIAL
                 ('¦  SPEED-----------:        KTS    ¦       SPEED-----
-----:
             -   KTS    ¦
                 ');
 241   1       DCL M5 (*) BYTE INITIAL
                 ('¦  BEARING---------:        DGS    ¦       LATITUDE--
-----:
             -   DGS    ¦
```

```
                ');
 242   1        DCL M6 (*) BYTE INITIAL
                ('¦  RANGE-----------:        YDS   ¦        LONGITUDE-
-----:     .
            -    DGS   ¦
                ');
 243   1        DCL M7 (*) BYTE INITIAL
                ('¦  CPA TIME--------:    .   H.M   ¦        QUADRANT N
UMBER:
            -         ¦
                ');
 244   1        DCL M8 (*) BYTE INITIAL
                ('¦  CPA DISTANCE----:        YDS   ¦

            -         ¦
                ');
 245   1        DCL M9 (*) BYTE INITIAL
                ('¦  LATITUDE--------:    .   DGS   ¦

            -         ¦
                ');
 246   1        DCL M10 (*) BYTE INITIAL
                ('¦  LONGITUDE-------:    .   DGS   ¦

            -         ¦
                ');
```

```
 247   1       DCL M11 (*) BYTE INITIAL
               ('¦  COLLISION STATUS:              ¦

           -          ¦
               ');
 248   1       DCL M12 (*) BYTE INITIAL
               ('¦  QUADRANT NUMBER-:              ¦

           -          ¦
               ');
 249   1       DCL M13 (*) BYTE INITIAL
               ('¦--------------------------------¦----------------
-------------
           -   ------¦
               ');


 250   1       WRITE$BIGPICTURE: PROCEDURE PUBLIC;

                /* THIS PROCEDURE WRITES BIG$PICTURE TO MDS CRT OR LI
NE PRINTER */
 251   2       DCL (I,J,K) ADDRESS ;
 252   2       I=73;
 253   2       CALL WRITE (0,.M0(0),I,.WRITE$STATUS);
```

279

```
254   2       CALL CRLF;
255   2       CALL WRITE (0,.L0(0) ,I,.WRITE$STATUS);
256   2       CALL CRLF;
257   2       CALL WRITE (0,.L1(0),I,.WRITE$STATUS);
258   2       CALL CRLF;
259   2       CALL WRITE (0,.L2(0),I,.WRITE$STATUS);
260   2       CALL CRLF;
261   2       CALL WRITE (0,.L3(0),I,.WRITE$STATUS);
262   2       CALL CRLF;
263   2       CALL WRITE (0,.L4(0),I,.WRITE$STATUS);
264   2       CALL CRLF;
265   2       CALL WRITE (0,.L5(0),I,.WRITE$STATUS);
266   2       CALL CRLF;
267   2       CALL WRITE (0,.L6(0),I,.WRITE$STATUS);
268   2       CALL CRLF;
269   2       CALL WRITE (0,.L7(0),I,.WRITE$STATUS);
270   2       CALL CRLF;
271   2       CALL WRITE (0,.L8(0),I,.WRITE$STATUS);
272   2       CALL CRLF;
273   2       CALL WRITE (0,.L9(0),I,.WRITE$STATUS);
274   2       CALL CRLF;
```

```
275   2      CALL WRITE (0,.L10(0),I,.WRITE$STATUS);
276   2      CALL CRLF;
277   2      CALL WRITE (0,.L11(0),I,.WRITE$STATUS);
278   2      CALL CRLF;
279   2      CALL WRITE (0,.L12(0),I,.WRITE$STATUS);
280   2      CALL CRLF;
281   2      CALL WRITE (0,.L13(0),I,.WRITE$STATUS);
282   2      CALL CRLF;
283   2      CALL WRITE (0,.L14(0),I,.WRITE$STATUS);
284   2      CALL CRLF;
285   2      CALL WRITE (0,.L15(0),I,.WRITE$STATUS);
286   2      CALL CRLF;
287   2      CALL WRITE (0,.L16(0),I,.WRITE$STATUS);
288   2      CALL CRLF;
289   2      CALL WRITE (0,.L17(0),I,.WRITE$STATUS);
290   2      CALL CRLF;
291   2      END;/* WRITE$BIGPICTURE */


292   1      WRITE$LITTLEPICTURE: PROCEDURE PUBLIC;
```

```
                /* THIS PROCEDURE WRITES LITTLE$PICTURE TO MDS CRT OR
LINE PRINTER
          -   */
293   2       DCL (L,M,N) ADDRESS;
294   2       L=73;
295   2       CALL WRITE(0,.M0(0),L,.WRITE$STATUS);
296   2       CALL CRLF;
297   2       CALL WRITE(0,.M1(0),L,.WRITE$STATUS);
298   2       CALL CRLF;
299   2       CALL WRITE(0,.M2(0),L,.WRITE$STATUS);
300   2       CALL CRLF;
301   2       CALL WRITE(0,.M3(0),L,.WRITE$STATUS);
302   2       CALL CRLF;
303   2       CALL WRITE(0,.M4(0),L,.WRITE$STATUS);
304   2       CALL CRLF;
305   2       CALL WRITE(0,.M5(0),L,.WRITE$STATUS);
306   2       CALL CRLF;
307   2       CALL WRITE(0,.M6(0),L,.WRITE$STATUS);
308   2       CALL CRLF;
309   2       CALL WRITE(0,.M7(0),L,.WRITE$STATUS);
310   2       CALL CRLF;
```

```
311   2       CALL WRITE(0,.M8(0),L,.WRITE$STATUS);
312   2       CALL CRLF;
313   2       CALL WRITE(0,.M9(0),L,.WRITE$STATUS);
314   2       CALL CRLF;
315   2       CALL WRITE(0,.M10(0),L,.WRITE$STATUS);
316   2       CALL CRLF;
317   2       CALL WRITE(0,.M11(0),L,.WRITE$STATUS);
318   2       CALL CRLF;
319   2       CALL WRITE(0,.M12(0),L,.WRITE$STATUS);
320   2       CALL CRLF;
321   2       CALL WRITE(0,.M13(0),L,.WRITE$STATUS);
322   2       CALL CRLF;
323   2       END; /*WRITE$LITTLEPICTURE */
```

```
                /* INCLUDE PROCEDURES TO WRITE BIG AND LITTLE PICTURE
TO LP. */
                $INCLUDE(:F1:WRITE.LP)
 324    1   =   OUTPUT$STATUS$LP: PROCEDURE BYTE;
              =
              =   /* TRUE IF DATA OUTPUT LINE TO LP READY */
 325    2   =   RETURN ROR(INPUT(245),2);
 326    2   =   END;
              =
              =
              =
 327    1   =   SEND$CHAR$LP: PROCEDURE (CHAR);
              =
              =   /* SEND A CHARACTER TO THE LINE PRINTER  */
 328    2   =   DCL CHAR BYTE;
 329    2   =   DO WHILE NOT OUTPUT$STATUS$LP;
 330    3   =     END; /* DO WHILE */
 331    2   =   OUTPUT(244)=CHAR;
 332    2   =   END;
              =
              =
              =
```

```
 333   1   =   LPCRLF: PROCEDURE;
             =
             =   /* SEND CARRIAGE RETURN AND LINE FEED TO THE LP. */
 334   2   =   CALL SEND$CHAR$LP(0DH);
 335   2   =   CALL SEND$CHAR$LP(0AH);
 336   2   =   END;
             =
             =
             =
             =
 337   1   =   WRITE$BIGPICTURE$LP: PROCEDURE PUBLIC;
             =
             =    /* THIS PROCEDURE WRITES BIG$PICTURE TO MDS CRT OR LI
NE PRINTER */
 338   2   =   DCL (I,J,K) ADDRESS ;
 339   2   =   I=73;
 340   2   =   DO J = 1 TO 15 ;
 341   3   =         CALL LPCRLF;
 342   3   =   END; /* DO J */
 343   2   =   CALL WRITE (0,.M0(0),I,.WRITE$STATUS);
 344   2   =   CALL LPCRLF;
 345   2   =   DO J= 1 TO 5;
```

```
346   3  =          CALL LPCRLF;
347   3  =    END; /* DO J */
348   2  =    CALL WRITE (0,.L17(0),I,.WRITE$STATUS);
349   2  =    CALL LPCRLF;
350   2  =    CALL WRITE (0,.L0(0) ,I,.WRITE$STATUS);
351   2  =    CALL LPCRLF;
352   2  =    CALL WRITE (0,.L1(0),I,.WRITE$STATUS);
353   2  =    CALL LPCRLF;
354   2  =    CALL WRITE (0,.L2(0),I,.WRITE$STATUS);
355   2  =    CALL LPCRLF;
356   2  =    CALL WRITE (0,.L3(0),I,.WRITE$STATUS);
357   2  =    CALL LPCRLF;
358   2  =    CALL WRITE (0,.L4(0),I,.WRITE$STATUS);
359   2  =    CALL LPCRLF;
360   2  =    CALL WRITE (0,.L5(0),I,.WRITE$STATUS);
361   2  =    CALL LPCRLF;
362   2  =    CALL WRITE (0,.L6(0),I,.WRITE$STATUS);
363   2  =    CALL LPCRLF;
364   2  =    CALL WRITE (0,.L7(0),I,.WRITE$STATUS);
365   2  =    CALL LPCRLF;
366   2  =    CALL WRITE (0,.L8(0),I,.WRITE$STATUS);
```

```
367   2  =    CALL LPCRLF;
368   2  =    CALL WRITE (0,.L9(0),I,.WRITE$STATUS);
369   2  =    CALL LPCRLF;
370   2  =    CALL WRITE (0,.L10(0),I,.WRITE$STATUS);
371   2  =    CALL LPCRLF;
372   2  =    CALL WRITE (0,.L11(0),I,.WRITE$STATUS);
373   2  =    CALL LPCRLF;
374   2  =    CALL WRITE (0,.L12(0),I,.WRITE$STATUS);
375   2  =    CALL LPCRLF;
376   2  =    CALL WRITE (0,.L13(0),I,.WRITE$STATUS);
377   2  =    CALL LPCRLF;
378   2  =    CALL WRITE (0,.L14(0),I,.WRITE$STATUS);
379   2  =    CALL LPCRLF;
380   2  =    CALL WRITE (0,.L15(0),I,.WRITE$STATUS);
381   2  =    CALL LPCRLF;
382   2  =    CALL WRITE (0,.L16(0),I,.WRITE$STATUS);
383   2  =    CALL LPCRLF;
384   2  =    CALL WRITE (0,.L17(0),I,.WRITE$STATUS);
385   2  =    CALL LPCRLF;
386   2  =    END;/* WRITE$BIGPICTURE */
           =
```

```
          =
          =
387   1   =    WRITE$LITTLEPICTURE$LP: PROCEDURE PUBLIC;
          =
          =     /* THIS PROCEDURE WRITES LITTLE$PICTURE TO MDS CRT OR
LINE PRINTER
          -     */
388   2   =    DCL (L,M,N) ADDRESS;
389   2   =    L=73;
390   2   =    DO M = 1 TO 15;
391   3   =         CALL LPCRLF;
392   3   =    END; /* DO M */
393   2   =    CALL WRITE(0,.M0(0),L,.WRITE$STATUS);
394   2   =    CALL LPCRLF;
395   2   =    DO M = 1 TO 5;
396   3   =       CALL LPCRLF;
397   3   =    END ; /* DO M */
398   2   =    CALL WRITE (0,.M13(0),L,.WRITE$STATUS);
399   2   =    CALL LPCRLF;
400   2   =    CALL WRITE(0,.M1(0),L,.WRITE$STATUS);
401   2   =    CALL LPCRLF;
402   2   =    CALL WRITE(0,.M2(0),L,.WRITE$STATUS);
```

```
403   2  =    CALL LPCRLF;
404   2  =    CALL WRITE(0,.M3(0),L,.WRITE$STATUS);
405   2  =    CALL LPCRLF;
406   2  =    CALL WRITE(0,.M4(0),L,.WRITE$STATUS);
407   2  =    CALL LPCRLF;
408   2  =    CALL WRITE(0,.M5(0),L,.WRITE$STATUS);
409   2  =    CALL LPCRLF;
410   2  =    CALL WRITE(0,.M6(0),L,.WRITE$STATUS);
411   2  =    CALL LPCRLF;
412   2  =    CALL WRITE(0,.M7(0),L,.WRITE$STATUS);
413   2  =    CALL LPCRLF;
414   2  =    CALL WRITE(0,.M8(0),L,.WRITE$STATUS);
415   2  =    CALL LPCRLF;
416   2  =    CALL WRITE(0,.M9(0),L,.WRITE$STATUS);
417   2  =    CALL LPCRLF;
418   2  =    CALL WRITE(0,.M10(0),L,.WRITE$STATUS);
419   2  =    CALL LPCRLF;
420   2  =    CALL WRITE(0,.M11(0),L,.WRITE$STATUS);
421   2  =    CALL LPCRLF;
422   2  =    CALL WRITE(0,.M12(0),L,.WRITE$STATUS);
423   2  =    CALL LPCRLF;
```

```
 424   2  =    CALL WRITE(0,.M13(0),L,.WRITE$STATUS);
 425   2  =    CALL LPCRLF;
 426   2  =    END; /*WRITE$LITTLEPICTURE */


 427   1       CONVERT$ADDRESS$TO$CHARS: PROCEDURE (CHAR$ADDRESS) PUB
LIC;

                 /* THIS PROCEDURE CONVERTS THE NUMERIC VALUE OF A ADD
RESS
                    VARIABLE TO A FIVE CHARACTER BYTE REPRESENTATION.
*/
 428   2       DCL SCALE$FACTOR (5)  ADDRESS DATA (10000,1000,100,10,
1);
 429   2       DCL (JA,IA,PASS$COUNT) BYTE ;
 430   2       DCL (CHAR,TEMP,CHAR$ADDRESS) ADDRESS;
 431   2       CHAR=CHAR$ADDRESS;
 432   2       JA=4;
 433   2       DO IA=0 TO LAST(SCALE$FACTOR);
 434   3          PASS$COUNT=0;
 435   3          TEMP=SCALE$FACTOR(IA);
 436   3          DO WHILE CHAR >= TEMP;
 437   4            CHAR=CHAR-TEMP;
 438   4            PASS$COUNT=PASS$COUNT+1;
 439   4          END; /* DO WHILE CHAR */
```

```
440   3          CONVERTED$BYTE$NUMBER(JA)=(PASS$COUNT+'0');
441   3          JA=JA-1;
442   3        END; /* DO IA */
443   2        END; /* CONVERT$ADDRESS$TO$CHARS */



444   1        CONVERT$BYTE$TO$CHARS:PROCEDURE (CHAR$BYTE) PUBLIC ;

                /* THIS PROCEDURE CONVERTS THE NUMERIC VALUE OF A BYT
E VARIABLE
                   TO 3 CHARACTER BYTE REPRESENTATION . */
445   2        DCL SCALE$FACTOR (3)  BYTE DATA (100,10,1) ;
446   2        DCL (JB,IB,CHAR,CHAR$BYTE,PASS$COUNT,TEMP) BYTE;
447   2        CHAR=CHAR$BYTE;
448   2        JB=2;
449   2        DO IB=0 TO LAST(SCALE$FACTOR);
450   3          PASS$COUNT=0;
451   3          TEMP=SCALE$FACTOR(IB);
452   3          DO WHILE CHAR>= TEMP;
453   4            CHAR=CHAR-TEMP;
454   4            PASS$COUNT=PASS$COUNT + 1;
```

```
 455   4          END; /* DO WHILE */
 456   3          CONVERTED$BYTE$NUMBER(JB) = ( PASS$COUNT + '0');
 457   3          JB=JB-1;
 458   3       END; /* DO IB */
 459   2       END; /* CONVERT$BYTE$TO$CHARS$ */


 460   1       LOAD$DATA$BIGPICTURE: PROCEDURE (PTR,P$COUNT,IDATA,JDA
TA);

                 /* THIS PROCEDURE TRANSFERS LATEST SHIP PLOT STRUCTUR
E TO
                       MEMORY-LINE ARRAYS FOR MAPPING TO CRT OR LINE
PRINTER */
 461   2       DCL (PTR,P$COUNT,TEMP) ADDRESS;
 462   2       DCL (I,J,IDATA,JDATA) BYTE ; /* IDATA=INDEX , JDATA=SH
IPINDEX. */
 463   2       DCL P BASED PTR BYTE ;
 464   2       DCL DIRECTION BYTE;
 465   2       I=IDATA;
 466   2       J=JDATA;
                 /* INITIALIZE CONTACT NUMBER */
 467   2       PTR =PTR+4;
 468   2       DO CASE I;
 469   3       P='F';
```

```
470   3       P='H';
471   3       P='U';
472   3       END; /* CASE */
473   2       PTR=PTR+1 ;
474   2       P=(J+'0');
                /* INITIALIZE QUADRANT */
475   2       PTR=PTR+8;
476   2       CALL CONVERT$BYTE$TO$CHARS(SHIP$PLOT(I).QUADRANT(J));
477   2       P=CONVERTED$BYTE$NUMBER(1);
478   2       PTR=PTR+1;
479   2       P=CONVERTED$BYTE$NUMBER(0);
                /* INITIALIZE STATUS */
480   2       PTR=PTR+8;
481   2       DO CASE I;
482   3       P='F';
483   3       P='H';
484   3       P='U';
485   3       END; /* CASE */
486   2       PTR=PTR+1;
487   2       DO CASE I;
488   3       P='R';
```

```
489   3       P='0';
490   3       P='N';
491   3       END; /* CASE */
              /* INITIALIZE TYPE **********************/
492   2       PTR=PTR+8;
493   2       PTR=PTR+1;
              /* INITIALIZE COURSE */
494   2       PTR=PTR+6;
495   2       CALL CONVERT$ADDRESS$TO$CHARS(SHIP$PLOT(I).COURSE(J));
496   2       P=CONVERTED$BYTE$NUMBER(2);
497   2       PTR=PTR+1;
498   2       P=CONVERTED$BYTE$NUMBER(1);
499   2       PTR=PTR+1;
500   2       P=CONVERTED$BYTE$NUMBER(0);
              /* INITIALIZE SPEED */
501   2       PTR=PTR+7;
502   2       CALL CONVERT$BYTE$TO$CHARS(SHIP$PLOT(I).SPEED(J));
503   2       P=CONVERTED$BYTE$NUMBER(1);
504   2       PTR=PTR+1;
505   2       P=CONVERTED$BYTE$NUMBER(0);
              /* INITIALIZE BEARING */
```

```
                /* CHECK FLAG FOR PORT OR STARBOARD */
506    2        PTR=PTR+7;
507    2        IF SHIP$PLOT(I).BEARING(J) >= 02000H THEN
508    2           DO;
509    3             DIRECTION = 'S';
510    3             TEMP = SHIP$PLOT(I).BEARING(J) AND 01FFFH;
511    3           END;
                ELSE
512    2        DO;
513    3        DIRECTION='P';
514    3        TEMP = SHIP$PLOT(I).BEARING(J);
515    3        END;
516    2        CALL CONVERT$ADDRESS$TO$CHARS(TEMP);
517    2        P=CONVERTED$BYTE$NUMBER(2);
518    2        PTR=PTR+1;
519    2        P=CONVERTED$BYTE$NUMBER(1);
520    2        PTR=PTR+1;
521    2        P=CONVERTED$BYTE$NUMBER(0);
522    2        PTR = PTR + 1;
523    2        P=DIRECTION;
524    2        IF ((I=0) AND (J=1)) THEN P=' ';
```

```
 526   2      IF ((TEMP = 0) OR (TEMP = 180)) THEN P = ' ';
              /* INITIALIZE RANGE */
 528   2      PTR=PTR+6;
 529   2      CALL CONVERT$ADDRESS$TO$CHARS(SHIP$PLOT(I).RANGE(J));
 530   2      P=CONVERTED$BYTE$NUMBER(4);
 531   2      PTR=PTR+1;
 532   2      P=CONVERTED$BYTE$NUMBER(3);
 533   2      PTR=PTR+1;
 534   2      P=CONVERTED$BYTE$NUMBER(2);
 535   2      PTR=PTR+1;
 536   2      P=CONVERTED$BYTE$NUMBER(1);
 537   2      PTR=PTR+1;
 538   2      P=CONVERTED$BYTE$NUMBER(0);
 539   2      PTR=PTR+1;
 540   2      P='0';
 541   2      END; /* LOAD$DATA$BIGPICTURE */


 542   1      LOAD$DATA$LITTLEPICTURE: PROCEDURE (ILITTLE,JLITTLE) P
UBLIC ;
```

```
                /* THIS PROCEDURE LOADS A SPECIFIC CONTACT INTO MEMOR
Y/LINE
                   ARRAY FOR MAPPING TO THE CRT OR LINE PRINTER. */
 543   2       DCL (I,J,ILITTLE,JLITTLE) BYTE ; /* ILITTLE=INDEX , JL
ITTLE=SHIPINDE
           -    X. */
 544   2       DCL (N,K) BYTE;
 545   2       DCL DIRECTION BYTE;
 546   2       DCL TEMP ADDRESS;
 547   2       I=ILITTLE;
 548   2       J=JLITTLE;
                /* INITIALIZE CONTACT NUMBER */
 549   2       M1(20)=I;
 550   2       M1(21)=J;
                /* CONVERT F,U,H SYMBOLS TO SHIP PLOT INDEX . */
 551   2       IF I='F' THEN I=0;
                ELSE
 553   2       IF I='H' THEN I=1;
                ELSE
 555   2       IF I='U' THEN I=2;
                J=J-'0';
                /* INITIALIZE CONTACT AND OWNSHIP COURSE */
 558   2       CALL CONVERT$ADDRESS$TO$CHARS(SHIP$PLOT(I).COURSE(J));
```

```
559   2       N=26;
560   2       DO K=0 TO 2;
561   3         M3(N-K)=CONVERTED$BYTE$NUMBER(K);
562   3       END;
563   2       CALL CONVERT$ADDRESS$TO$CHARS(SHIP$PLOT(0).COURSE(1));
564   2       N=64;
565   2       DO K=0 TO 2;
566   3         M3(N-K)=CONVERTED$BYTE$NUMBER(K);
567   3       END;
               /* INITIALIZE CONTACT AND OWN SHIP SPEED */
568   2       CALL CONVERT$BYTE$TO$CHARS(SHIP$PLOT(I).SPEED(J));
569   2       N=26;
570   2       DO K=0 TO 1;
571   3         M4(N-K)=CONVERTED$BYTE$NUMBER(K);
572   3       END;
573   2       CALL CONVERT$BYTE$TO$CHARS(SHIP$PLOT(0).SPEED(1));
574   2       N=64;
575   2       DO K=0 TO 1;
576   3         M4(N-K)=CONVERTED$BYTE$NUMBER(K);
577   3       END;
               /* INITIALIZE CONTACT BEARING AND OWNSHIP LATITUDE */
```

```
                /* CHECK FLAG FOR PORT OR STARBOARD */
 578   2        IF SHIP$PLOT(I).BEARING(J) >= 02000H THEN
 579   2            DO;
 580   3              DIRECTION='S';
 581   3              TEMP = SHIP$PLOT(I).BEARING(J) AND 01FFFH;
 582   3            END;
                ELSE
 583   2        DO;
 584   3        DIRECTION ='P' ;
 585   3        TEMP = SHIP$PLOT(I).BEARING(J);
 586   3        END;
 587   2        CALL CONVERT$ADDRESS$TO$CHARS(TEMP);
 588   2        N=25;
 589   2        DO K =0 TO 2;
 590   3          M5(N-K)=CONVERTED$BYTE$NUMBER(K);
 591   3        END;
 592   2        M5(26)= DIRECTION ;
 593   2        IF ((I=0) AND (J=1)) THEN M5(26)=' ' ;
 595   2        IF ((TEMP = 0) OR (TEMP = 180)) THEN M5(26) = ' ';
                /* CHECK FLAG FOR NORTH OR SOUTH */
 597   2        IF SHIP$PLOT(0).LAT(1) >= 02000H THEN
```

```
598   2          DO;
599   3            M5(64)='N';
600   3            TEMP = SHIP$PLOT(0).LAT(1) AND 01FFFH;
601   3          END;
                 ELSE
602   2          DO;
603   3          M5(64)='S';
604   3          TEMP = SHIP$PLOT(0).LAT(1);
605   3          END;
606   2          CALL CONVERT$ADDRESS$TO$CHARS(TEMP);
607   2          M5(60)=CONVERTED$BYTE$NUMBER(2);
608   2          M5(61)=CONVERTED$BYTE$NUMBER(1);
609   2          M5(63)=CONVERTED$BYTE$NUMBER(0);
                 /* INITIALIZE CONTACT RANGE AND OWNSHIP LONGITUDE */
610   2          CALL CONVERT$ADDRESS$TO$CHARS(SHIP$PLOT(I).RANGE(J));
611   2          M6(26)='0';
612   2          N=25;
613   2          DO K=0 TO 4;
614   3            M6(N-K)=CONVERTED$BYTE$NUMBER(K);
615   3          END;
                 /* CHECK FLAG FOR WEST OR EAST */
```

```
 616   2      IF SHIP$PLOT(0).LONG(1) >= 02000H THEN
 617   2         DO;
 618   3           M6(64)='W';
 619   3           TEMP = SHIP$PLOT(0).LONG(1) AND 01FFFH;
 620   3         END;
               ELSE
 621   2      DO;
 622   3      M6(64)='E';
 623   3      TEMP = SHIP$PLOT(0).LONG(1);
 624   3      END;
 625   2      CALL CONVERT$ADDRESS$TO$CHARS(TEMP);
 626   2      N=63;
 627   2      DO K=0 TO 3;
 628   3        IF K=1 THEN N=N-1;
 630   3        M6(N-K)=CONVERTED$BYTE$NUMBER(K);
 631   3      END;
               /*INITIALIZE CONTACT CPA-TIME AND OWNSHIP QUADRANT NUM
BER */
 632   2      CALL CONVERT$ADDRESS$TO$CHARS(SHIP$PLOT(I).CPA$TIME(J)
);
 633   2      N=26;
 634   2      DO K=0 TO 3;
 635   3        IF K=2 THEN N=N-1;
```

```
 637   3        M7(N-K)=CONVERTED$BYTE$NUMBER(K);
 638   3      END;
 639   2      CALL CONVERT$BYTE$TO$CHARS(SHIP$PLOT(0).QUADRANT(1));
 640   2      M7(63)=CONVERTED$BYTE$NUMBER(1);
 641   2      M7(64)=CONVERTED$BYTE$NUMBER(0);
              /* INITIALIZE CONTACT CPA-DISTANCE */
 642   2      CALL CONVERT$ADDRESS$TO$CHARS(SHIP$PLOT(I).CPA$DISTANC
E(J));
 643   2      N=25;
 644   2      DO K=0 TO 4;
 645   3         M8(N-K)=CONVERTED$BYTE$NUMBER(K);
 646   3      END;
 647   2      M8(26)='0';
              /* INITIALIZE CONTACT LATITUDE */
              /* CHECK FLAG FOR NORTH OR SOUTH */
 648   2      IF SHIP$PLOT(I).LAT(J) >= 02000H THEN
 649   2         DO;
 650   3           M9(26)='N';
 651   3           TEMP = SHIP$PLOT(I).LAT(J) AND 01FFFH;
 652   3         END;
              ELSE
 653   2      DO;
```

```
654   3       M9(26)='S';
655   3       TEMP = SHIP$PLOT(I).LAT(J);
656   3       END;
657   2       CALL CONVERT$ADDRESS$TO$CHARS(TEMP);
658   2       N=25;
659   2       DO K=0 TO 2;
660   3         IF K=1 THEN N=N-1;
662   3         M9(N-K)=CONVERTED$BYTE$NUMBER(K);
663   3       END;
              /* INITIALIZE CONTACT LONGITUDE */
              /* CHECK FLAG FOR WEST OR EAST */
664   2       IF SHIP$PLOT(I).LONG(J) >= 02000H THEN
665   2          DO;
666   3            M10(26)='W';
667   3            TEMP = SHIP$PLOT(I).LONG(J) AND 01FFFH;
668   3          END;
              ELSE
669   2       DO;
670   3       M10(26)='E';
671   3       TEMP = SHIP$PLOT(I).LONG(J);
672   3       END;
```

```
673   2       CALL CONVERT$ADDRESS$TO$CHARS(TEMP);
674   2       N=25;
675   2       DO K=0 TO 3;
676   3          IF K=1 THEN N=N-1;
678   3          M10(N-K)=CONVERTED$BYTE$NUMBER(K);
679   3       END;
               /*INITIALIZE CONTACT COLLISION STATUS */
680   2       IF SHIP$PLOT(I).COLLISION$FLAG(J)=03H THEN
681   2       DO;
682   3         M11(20)=0EH;
683   3         M11(30)=18H;
684   3         M11(21)='C';
685   3         M11(22)='O';
686   3         M11(23)='L';
687   3         M11(24)='L';
688   3         M11(25)='I';
689   3         M11(26)='S';
690   3         M11(27)='I';
691   3         M11(28)='O';
692   3         M11(29)='N';
693   3       END; /* IF */
```

```
                ELSE
694    2        DO;
695    3        N=20;
696    3        DO K=0 TO 10;
697    4          M11(N)=' ';
698    4          N=N+1;
699    4        END; /* DO */
700    3        END; /* ELSE */
                /*INITIALIZE CONTACT QUADRANT NUMBER */
701    2        CALL CONVERT$BYTE$TO$CHARS(SHIP$PLOT(I).QUADRANT(J));
702    2        M12(25)=CONVERTED$BYTE$NUMBER(1);
703    2        M12(26)=CONVERTED$BYTE$NUMBER(0);
704    2        END; /* LOAD$DATA$LITTLEPICTURE */
```



```
705    1        LOAD$LINE$ARRAY: PROCEDURE (A,B,C) ;
```

```
                /* THIS PROCEDURE PASSES LINE ARRAY,INDEX,AND SHIPIND
EX TO
                   LOAD DATA TO BIG OR LITTLE PICTURE. */
 706    2       DCL (A,D) ADDRESS;
 707    2       DCL (B,C) BYTE ;
 708    2       D=73;
 709    2       DO CASE A;
 710    3         CALL LOAD$DATA$BIGPICTURE(.L0(0),D,B,C);
 711    3         CALL LOAD$DATA$BIGPICTURE(.L1(0),D,B,C);
 712    3         CALL LOAD$DATA$BIGPICTURE(.L2(0),D,B,C);
 713    3         CALL LOAD$DATA$BIGPICTURE(.L3(0),D,B,C);
 714    3         CALL LOAD$DATA$BIGPICTURE(.L4(0),D,B,C);
 715    3         CALL LOAD$DATA$BIGPICTURE(.L5(0),D,B,C);
 716    3         CALL LOAD$DATA$BIGPICTURE(.L6(0),D,B,C);
 717    3         CALL LOAD$DATA$BIGPICTURE(.L7(0),D,B,C);
 718    3         CALL LOAD$DATA$BIGPICTURE(.L8(0),D,B,C);
 719    3         CALL LOAD$DATA$BIGPICTURE(.L9(0),D,B,C);
 720    3         CALL LOAD$DATA$BIGPICTURE(.L10(0),D,B,C);
 721    3         CALL LOAD$DATA$BIGPICTURE(.L11(0),D,B,C);
 722    3         CALL LOAD$DATA$BIGPICTURE(.L12(0),D,B,C);
 723    3         CALL LOAD$DATA$BIGPICTURE(.L13(0),D,B,C);
 724    3         CALL LOAD$DATA$BIGPICTURE(.L14(0),D,B,C);
```

```
 725   3        CALL LOAD$DATA$BIGPICTURE(.L15(0),D,B,C);
 726   3        CALL LOAD$DATA$BIGPICTURE(.L16(0),D,B,C);
 727   3        CALL LOAD$DATA$BIGPICTURE(.L17(0),D,B,C);
 728   3      END; /* CASE A */
 729   2      END; /* LOAD$LINE$ARRAY */



 730   1      BLANK: PROCEDURE (PTR,P$COUNT);

               /* THIS PROCEDURE LOADS BLANKS IN THE BIG PICTURE */
 731   2      DCL (PTR,P$COUNT) ADDRESS ;
 732   2      DCL I BYTE ;
 733   2      DCL P BASED PTR BYTE ;
 734   2      DO I=0 TO (P$COUNT-1);
 735   3        IF (((P>='0') AND (P<='9')) OR (P='F') OR (P='R') OR
(P='H') OR (P
           -    ='O') OR
                    (P='U') OR (P='N') OR (P='P') OR (P='S')) THE
N
 736   3          P=' ';
 737   3        PTR = PTR + 1;
 738   3      END; /* DO I */
```

```
 739   2       END; /* BLANK */



 740   1       LOAD$BLANKS: PROCEDURE ( BL ,N ) ;

                  /* THIS PROCEDURE LOCATES APPROPIATE LINE ARRAY FOR B
LANKING */
 741   2       DCL (BL,N) ADDRESS ;
 742   2       DO CASE BL;
 743   3         CALL BLANK(.L0(0),N);
 744   3         CALL BLANK(.L1(0),N);
 745   3         CALL BLANK(.L2(0),N);
 746   3         CALL BLANK(.L3(0),N);
 747   3         CALL BLANK(.L4(0),N);
 748   3         CALL BLANK(.L5(0),N);
 749   3         CALL BLANK(.L6(0),N);
 750   3         CALL BLANK(.L7(0),N);
 751   3         CALL BLANK(.L8(0),N);
 752   3         CALL BLANK(.L9(0),N);
 753   3         CALL BLANK(.L10(0),N);
 754   3         CALL BLANK(.L11(0),N);
```

```
 755   3          CALL BLANK(.L12(0),N);
 756   3          CALL BLANK(.L13(0),N);
 757   3          CALL BLANK(.L14(0),N);
 758   3          CALL BLANK(.L15(0),N);
 759   3          CALL BLANK(.L16(0),N);
 760   3          CALL BLANK(.L17(0),N);
 761   3        END; /* CASE */
 762   2        END; /* LOAD$BLANKS */


 763   1        INITIALIZE$LOAD$PICTURE: PROCEDURE (C) PUBLIC ;

                   /* THIS PROCEDURE INITIALIZES TRANSFER OF STRUCTURE D
ATA
                      TO CRT-LINE PRINTER STATISTICAL INFORMATION. */
 764   2        DCL (C,F) ADDRESS ;
 765   2        DCL (INDEX,SHIPINDEX,D,E) BYTE ;
 766   2        DCL T$COUNT ADDRESS ;
 767   2        T$COUNT=C;
 768   2        D=0;
 769   2        F=73;
```

```
770   2       SHIPINDEX=0 ; /* SHIPINDEX */
771   2       DO INDEX=0 TO 2 ;
               /* INDEX */
772   3          IF (SHIP$PLOT(INDEX).COUNT) > 0 THEN
773   3            DO WHILE SHIPINDEX < SHIP$PLOT(INDEX).COUNT;
774   4              CALL LOAD$LINE$ARRAY(T$COUNT,INDEX,SHIPINDEX);
775   4              D=D+1;
776   4              T$COUNT = T$COUNT + 1;
777   4              SHIPINDEX =SHIPINDEX + 1;
778   4            END ; /* DO WHILE J */
779   3          SHIPINDEX=0;
780   3       END; /* DO INDEX */
781   2       IF ERASE$COUNT <= D THEN
782   2            ERASE$COUNT = D;
783   2       ELSE DO;
784   3            DO E = 1 TO (ERASE$COUNT-D);
785   4              CALL LOAD$BLANKS(T$COUNT,F);
786   4              T$COUNT=T$COUNT+1;
787   4            END; /* DO E */
788   3            ERASE$COUNT = D;
789   3            END; /* ELSE */
```

```
790   2       END; /* INITIALIZE$LOAD$PICTURE */



791   1       SET$STRUCTURE$ZEROES: PROCEDURE (PTR,P$COUNT) PUBLIC;

               /* THIS PROCEDURE SETS THE STRUCTURE TO ZEROES */
792   2       DCL (PTR,P$COUNT) ADDRESS;
793   2       DCL ZERO$COUNTER ADDRESS;
794   2       DCL P BASED PTR BYTE;
795   2       DO ZERO$COUNTER=0 TO (P$COUNT - 1);
796   3        P=0;
797   3        PTR=PTR+1;
798   3       END; /* DO */
799   2       END; /* SET$STRUCTURE$ZEROES */



800   1       END; /*SCREEN$MODULE */
```

MODULE INFORMATION:

```
     CODE AREA SIZE     = 179EH   6046D
     VARIABLE AREA SIZE = 09E4H   2532D
     MAXIMUM STACK SIZE = 0008H      8D
     1209 LINES READ
     0 PROGRAM ERROR(S)
```

END OF PL/M-80 COMPILATION

```
ISIS-II PL/M-80 V3.1 COMPILATION OF MODULE GRAPH1MODULE
NO OBJECT MODULE REQUESTED
COMPILER INVOKED BY:  PLM80 :F1:GRAPH1.MOD NOOBJECT PAGEWIDTH(82) PA
GELENGTH(24) D
                    -ATE(MAY 1979) TITLE('MODULE GRAPH1.MOD')



              /* THIS MODULE CONTAINS PROCEDURES TO DRAW SYMBOLS TO
THE
                   PLASMA DEVICES AND INTERACT WITH PLASMA TOUCH-PAN
EL. */

   1          GRAPH1$MODULE:
              DO;
   2   1      DECLARE SHIP$PLOT (15) STRUCTURE (
                        LAT(10) ADDRESS,
                        LONG(10) ADDRESS,
                        COURSE (10) ADDRESS,
                        SPEED(10) BYTE,
                        X$BOW(10) ADDRESS,
                        Y$BOW(10) ADDRESS,
                        QUADRANT(10) BYTE,
                        RANGE(10) ADDRESS,
```

```
                        BEARING(10) ADDRESS,
                        COLLISION$FLAG(10) BYTE,
                        CPA$TIME(10) ADDRESS,
                        CPA$DISTANCE(10) ADDRESS,
                        COUNT BYTE ) PUBLIC ;
  3   1         DECLARE JSPECIAL ADDRESS;
  4   1         DECLARE BACKUP$SHIP$COUNT BYTE;
  5   1         DECLARE LIT LITERALLY 'LITERALLY';
  6   1         DECLARE DCL LIT 'DECLARE';
  7   1         DCL TRUE LIT '0FFH';
  8   1         DCL FALSE LIT '000H';


                $NOLIST
                $INCLUDE(:F1:PLAPUB.EXT)
            =
            =
            =
            =   /* EXTERNAL PLASMA PUBLICS FOR PLASMA.DEVICE-ONE . */
            =
            =
```

```
      =
237   1  =    WRITE$CONTACT$ID: PROCEDURE (X,Y,J) EXTERNAL ;
238   2  =     DCL (ROW,COLUMN,J) BYTE ;
239   2  =     DCL (X,Y) ADDRESS ;
240   2  =     DCL CONTACT$ID (3) BYTE ;
241   2  =    END;
      =
      =
242   1  =    DRAW$GRID: PROCEDURE EXTERNAL;
243   2  =      DCL (X,Y) ADDRESS;
244   2  =    END;
      =
      =
245   1  =    DRAW$FRIEND$SYMBOL: PROCEDURE (X,Y,S) EXTERNAL;
246   2  =      DCL (X,Y,TX,TY) ADDRESS;
247   2  =      DCL S BYTE;
248   2  =    END;
      =
      =
249   1  =    DRAW$FRIEND$DASH: PROCEDURE (X,Y,S) EXTERNAL;
250   2  =      DCL (X,Y,TX,TY) ADDRESS;
```

```
251   2  =     DCL S BYTE;
252   2  =   END;
           =
           =
253   1  =   ERASE$FRIEND$DASH: PROCEDURE (X,Y,S) EXTERNAL;
254   2  =     DCL (X,Y,TX,TY) ADDRESS;
255   2  =     DCL S BYTE;
256   2  =   END;
           =
           =
257   1  =   ERASE$FRIEND$SYMBOL: PROCEDURE (X,Y,S) EXTERNAL;
258   2  =     DCL (X,Y,TX,TY) ADDRESS;
259   2  =     DCL S BYTE;
260   2  =   END;
           =
           =
261   1  =   DRAW$HOSTILE$SYMBOL: PROCEDURE (X,Y,S) EXTERNAL;
262   2  =     DCL (X,Y,TX,TY) ADDRESS;
263   2  =     DCL S BYTE;
264   2  =   END;
           =
```

```
          =
 265   1  =   DRAW$HOSTILE$DASH: PROCEDURE (X,Y,S) EXTERNAL;
 266   2  =     DCL (X,Y,TX,TY) ADDRESS;
 267   2  =     DCL S BYTE;
 268   2  =   END;
          =
          =
 269   1  =   ERASE$HOSTILE$SYMBOL: PROCEDURE (X,Y,S) EXTERNAL;
 270   2  =     DCL (X,Y,TX,TY) ADDRESS;
 271   2  =     DCL S BYTE;
 272   2  =   END;
          =
          =
 273   1  =   ERASE$HOSTILE$DASH: PROCEDURE (X,Y,S) EXTERNAL;
 274   2  =     DCL(X,Y,TX,TY) ADDRESS;
 275   2  =     DCL S BYTE;
 276   2  =   END;
          =
          =
 277   1  =   DRAW$UNKNOWN$SYMBOL: PROCEDURE (X,Y,S) EXTERNAL;
 278   2  =     DCL (X,Y,TX,TY) ADDRESS;
```

```
279   2  =     DCL S BYTE;
280   2  =   END;
           =
           =
281   1  =   ERASE$UNKNOWN$SYMBOL: PROCEDURE (X,Y,S) EXTERNAL;
282   2  =     DCL (X,Y,TX,TY) ADDRESS;
283   2  =     DCL S BYTE;
284   2  =   END;
           =
           =
285   1  =   DRAW$UNKNOWN$DASH: PROCEDURE (X,Y,S) EXTERNAL;
286   2  =     DCL (X,Y,TX,TY) ADDRESS;
287   2  =     DCL S BYTE;
288   2  =   END;
           =
           =
289   1  =   ERASE$UNKNOWN$DASH: PROCEDURE (X,Y,S) EXTERNAL;
290   2  =     DCL (X,Y,TX,TY) ADDRESS;
291   2  =     DCL S BYTE;
292   2  =   END;
           =
```

```
                =
                =   /* EXTERNAL PLASMA PUBLICS FOR PLASMA.DEVICE TWO. */
                =
                =
                =
 293    1       =   WRITE$CONTACT$ID$2: PROCEDURE (X,Y,J) EXTERNAL ;
 294    2       =   DCL (ROW,COLUMN,J) BYTE ;
 295    2       =   DCL (X,Y) ADDRESS ;
 296    2       =   DCL CONTACT$ID (3) BYTE ;
 297    2       =   END;
                =
                =
                =
 298    1       =   DRAW$GRID$2: PROCEDURE EXTERNAL;
 299    2       =     DCL (X,Y) ADDRESS;
 300    2       =   END;
                =
                =
 301    1       =   DRAW$FRIEND$SYMBOL$2: PROCEDURE (X,Y,S) EXTERNAL;
 302    2       =     DCL (X,Y,TX,TY) ADDRESS;
 303    2       =     DCL S BYTE;
```

```
304   2  =    END;
           =
           =
305   1  =    DRAW$FRIEND$DASH$2: PROCEDURE (X,Y,S) EXTERNAL;
306   2  =      DCL (X,Y,TX,TY) ADDRESS;
307   2  =      DCL S BYTE;
308   2  =    END;
           =
           =
309   1  =    ERASE$FRIEND$DASH$2: PROCEDURE (X,Y,S) EXTERNAL;
310   2  =      DCL (X,Y,TX,TY) ADDRESS;
311   2  =      DCL S BYTE;
312   2  =    END;
           =
           =
313   1  =    ERASE$FRIEND$SYMBOL$2: PROCEDURE (X,Y,S) EXTERNAL;
314   2  =      DCL (X,Y,TX,TY) ADDRESS;
315   2  =      DCL S BYTE;
316   2  =    END;
           =
           =
```

```
317   1   =   DRAW$HOSTILE$SYMBOL$2: PROCEDURE (X,Y,S) EXTERNAL;
318   2   =     DCL (X,Y,TX,TY) ADDRESS;
319   2   =     DCL S BYTE;
320   2   =   END;
          =
          =
321   1   =   DRAW$HOSTILE$DASH$2: PROCEDURE (X,Y,S) EXTERNAL;
322   2   =     DCL (X,Y,TX,TY) ADDRESS;
323   2   =     DCL S BYTE;
324   2   =   END;
          =
          =
325   1   =   ERASE$HOSTILE$SYMBOL$2: PROCEDURE (X,Y,S) EXTERNAL;
326   2   =     DCL (X,Y,TX,TY) ADDRESS;
327   2   =     DCL S BYTE;
328   2   =   END;
          =
          =
329   1   =   ERASE$HOSTILE$DASH$2: PROCEDURE (X,Y,S) EXTERNAL;
330   2   =     DCL(X,Y,TX,TY) ADDRESS;
331   2   =     DCL S BYTE;
```

```
 332   2  =    END;
            =
            =
 333   1  =    DRAW$UNKNOWN$SYMBOL$2: PROCEDURE (X,Y,S) EXTERNAL;
 334   2  =      DCL (X,Y,TX,TY) ADDRESS;
 335   2  =      DCL S BYTE;
 336   2  =    END;
            =
            =
 337   1  =    ERASE$UNKNOWN$SYMBOL$2: PROCEDURE (X,Y,S) EXTERNAL;
 338   2  =      DCL (X,Y,TX,TY) ADDRESS;
 339   2  =      DCL S BYTE;
 340   2  =    END;
            =
            =
 341   1  =    DRAW$UNKNOWN$DASH$2: PROCEDURE (X,Y,S) EXTERNAL;
 342   2  =      DCL (X,Y,TX,TY) ADDRESS;
 343   2  =      DCL S BYTE;
 344   2  =    END;
            =
            =
```

```
345   1  =   ERASE$UNKNOWN$DASH$2: PROCEDURE (X,Y,S) EXTERNAL;
346   2  =     DCL (X,Y,TX,TY) ADDRESS;
347   2  =     DCL S BYTE;
348   2  =   END;
           =
           =
               $INCLUDE(:F1:SERVE.SIX)
349   1  =   SERVICE$SIX: PROCEDURE PUBLIC;
           =
           =    /* THIS PROCEDURE SERVICE THE INTERRUPTS CAUSED BY
           =       THE PLASMA(DEVICE ONE) TOUCH-PANEL DEVICE.   */
           =
350   2  =    DCL (XY$DATAWORD,XY$DATAWORD$1,X$COOR,Y$COOR,INDEX,
           =         SHIPINDEX,FOUND$SHIP,QUADRANT$NUM,OWNSHIP) BYTE;
351   2  =    OWNSHIP = 1; /* INITIALIZE DESIGNATOR OF OWN SHIP */
352   2  =    XY$DATAWORD=INPUT(7);
353   2  =    XY$DATAWORD$1=XY$DATAWORD;
354   2  =    X$COOR=XY$DATAWORD AND ØFH;
355   2  =    Y$COOR=ROR(NOT(XY$DATAWORD),4)AND ØFH;
356   2  =   CALL CLEAR$PLASMA$2;
357   2  =   IF (X$COOR>=Ø) AND (X$COOR<=3) THEN
```

```
358   2  =    DO;
359   3  =      IF (Y$COOR>=0) AND (Y$COOR<=3) THEN
360   3  =          QUADRANT$NUM=1;
           =      ELSE
361   3  =      IF (Y$COOR>=4) AND (Y$COOR<=7) THEN
362   3  =          QUADRANT$NUM=5;
           =      ELSE
363   3  =      IF (Y$COOR>=8) AND (Y$COOR<=11) THEN
364   3  =          QUADRANT$NUM=9;
           =      ELSE
365   3  =      IF (Y$COOR>=12) AND (Y$COOR<=15) THEN
366   3  =          QUADRANT$NUM=13;
           =    END;
           =    ELSE
368   2  =    IF (X$COOR>=4) AND (X$COOR<=7) THEN
369   2  =    DO;
370   3  =      IF (Y$COOR>=0) AND (Y$COOR<=3) THEN
371   3  =          QUADRANT$NUM=2;
           =      ELSE
372   3  =      IF (Y$COOR>=4) AND (Y$COOR<=7) THEN
373   3  =          QUADRANT$NUM=6;
```

```
          =      ELSE
374   3   =      IF (Y$COOR>=8) AND (Y$COOR<=11) THEN
375   3   =          QUADRANT$NUM=10;
          =      ELSE
376   3   =      IF (Y$COOR>=12) AND (Y$COOR<=15) THEN
377   3   =          QUADRANT$NUM=14;
          =    END;
          =    ELSE
          =
379   2   =    IF (X$COOR>=8) AND (X$COOR<=11) THEN
380   2   =    DO;
381   3   =      IF (Y$COOR>=0) AND (Y$COOR<=3) THEN
382   3   =          QUADRANT$NUM=3;
          =      ELSE
383   3   =      IF (Y$COOR>=4) AND (Y$COOR<=7) THEN
384   3   =          QUADRANT$NUM=7;
          =      ELSE
385   3   =      IF (Y$COOR>=8) AND (Y$COOR<=11) THEN
386   3   =          QUADRANT$NUM=11;
          =      ELSE
387   3   =      IF (Y$COOR>=12) AND (Y$COOR<=15) THEN
```

```
388   3  =          QUADRANT$NUM=15;
         =    END;
         =    ELSE
         =
390   2  =    IF (X$COOR>=12) AND (X$COOR<=15) THEN
391   2  =    DO;
392   3  =      IF (Y$COOR>=0) AND (Y$COOR<=3) THEN
393   3  =          QUADRANT$NUM=4;
         =      ELSE
394   3  =      IF (Y$COOR>=4) AND (Y$COOR<=7) THEN
395   3  =          QUADRANT$NUM=8;
         =      ELSE
396   3  =      IF (Y$COOR>=8) AND (Y$COOR<=11) THEN
397   3  =          QUADRANT$NUM=12;
         =      ELSE
398   3  =      IF (Y$COOR>=12) AND (Y$COOR<=15) THEN
399   3  =          QUADRANT$NUM=16;
         =    END;
         =    INDEX=0;
402   2  =    SHIPINDEX=0;
403   2  =    DO WHILE INDEX < 3;
```

```
 404   3  =     IF(SHIP$PLOT(INDEX).COUNT) > 0 THEN
 405   3  =       DO WHILE SHIPINDEX < SHIP$PLOT(INDEX).COUNT;
 406   4  =         IF(SHIP$PLOT(INDEX).QUADRANT(SHIPINDEX)=QUADRANT
$NUM) THEN
 407   4  =         DO;
 408   5  =           FOUND$SHIP=TRUE;
 409   5  =           IF INDEX=0 THEN
 410   5  =           CALL DRAW$FRIEND$SYMBOL$2(
            =            SHIP$PLOT(0).X$BOW(SHIPINDEX),
            =            SHIP$PLOT(0).Y$BOW(SHIPINDEX),1);
            =           ELSE
 411   5  =           IF INDEX=1 THEN
 412   5  =           CALL DRAW$HOSTILE$SYMBOL$2(
            =            SHIP$PLOT(1).X$BOW(SHIPINDEX),
            =            SHIP$PLOT(1).Y$BOW(SHIPINDEX),1);
            =           ELSE
 413   5  =           IF INDEX=2 THEN
 414   5  =           CALL DRAW$UNKNOWN$SYMBOL$2(
            =            SHIP$PLOT(2).X$BOW(SHIPINDEX),
            =            SHIP$PLOT(2).Y$BOW(SHIPINDEX),1);
            =
            =     /* WRITE$CONTACT$ID NEXT TO SYMBOL */
```

```
          =
          =            IF (SHIP$PLOT(INDEX).X$BOW(SHIPINDEX) <= 486)
 THEN
 416   5  =                CALL WRITE$CONTACT$ID$2(SHIP$PLOT(INDEX).
X$BOW(SHIPINDE
           -   X)+11,
          =                     SHIP$PLOT(INDEX).Y$BOW(SHIPINDEX)+8,
SHIPINDEX);
          =             ELSE
 417   5  =                CALL WRITE$CONTACT$ID$2(SHIP$PLOT(INDEX).
X$BOW(SHIPINDE
           -   X)-18,
          =                     SHIP$PLOT(INDEX).Y$BOW(SHIPINDEX)+8,
SHIPINDEX);
          =
 418   5  =           CALL START$VECTOR$DASH$2(
          =             SHIP$PLOT(0).X$BOW(OWNSHIP),
          =             SHIP$PLOT(0).Y$BOW(OWNSHIP));
 419   5  =            CALL STOP$VECTOR$DASH$2(
          =             SHIP$PLOT(INDEX).X$BOW(SHIPINDEX),
          =             SHIP$PLOT(INDEX).Y$BOW(SHIPINDEX));
 420   5  =         END;
 421   4  =    SHIPINDEX=SHIPINDEX+1;
 422   4  =    IF (INDEX=0) AND (SHIPINDEX = OWNSHIP)
          =        THEN SHIPINDEX = SHIPINDEX + 1;
 424   4  =    END; /* DO WHILE SHIPINDEX */
```

```
 425   3  =   SHIPINDEX=0;
 426   3  =   INDEX=INDEX+1;
 427   3  =   END; /* DO WHILE INDEX */
 428   2  =   IF FOUND$SHIP=TRUE THEN
 429   2  =      DO;
 430   3  =      CALL DRAW$FRIEND$SYMBOL$2(
            =       SHIP$PLOT(0).X$BOW(OWNSHIP),
            =       SHIP$PLOT(0).Y$BOW(OWNSHIP),1);
            =
            =    /* WRITE OWNSHIP ID NEXT TO SYMBOL */
 431   3  =       IF (SHIP$PLOT(0).X$BOW(OWNSHIP) <= 486 ) THEN
 432   3  =          CALL WRITE$CONTACT$ID$2(SHIP$PLOT(0).X$BOW(OWNS
HIP) +11,
            =               SHIP$PLOT(0).Y$BOW(OWNSHIP) + 8 ,OWNSHIP);
            =         ELSE
 433   3  =          CALL WRITE$CONTACT$ID$2(SHIP$PLOT(0).X$BOW(OWNS
HIP) - 18,
            =               SHIP$PLOT(0).Y$BOW(OWNSHIP) + 8,OWNSHIP);
            =
 434   3  =         END; /* END IF FOUND$SHIP = TRUE */
            =   /* ELSE ****************/
 435   2  =   END; /* SERVICE SIX */
            =
```

```
            =
            =
 436    1   =    QUAD$NUM: PROCEDURE (X,Y)  BYTE PUBLIC;
            =
            =     /* THIS PROCEDURE CONVERTS ABSOLUTE X,Y COORDINATES O
F
            =        THE PLASMA (DEVICE ONE) TO QUADRANT NUMBERS AS DEF
I-
            =        NED FOR THE TOUCH-PANEL .   */
 437    2   =    DECLARE (X,Y) ADDRESS ;
 438    2   =    DECLARE QUADRANT$NUM BYTE ;
 439    2   =    IF (X>=0) AND (X<=127) THEN
 440    2   =    DO;
 441    3   =      IF (Y>=0) AND (Y<=127) THEN
 442    3   =          QUADRANT$NUM=1;
            =      ELSE
 443    3   =      IF (Y>=128) AND (Y<=255) THEN
 444    3   =          QUADRANT$NUM=5;
            =      ELSE
 445    3   =      IF (Y>=256) AND (Y<=383) THEN
 446    3   =          QUADRANT$NUM=9;
            =      ELSE
 447    3   =      IF (Y>=384) AND (Y<=511) THEN
```

```
448   3  =          QUADRANT$NUM=13;
           =    END;
           =    ELSE
450   2  =    IF (X>=128) AND (X<=255) THEN
451   2  =    DO;
452   3  =      IF (Y>=0) AND (Y<=127) THEN
453   3  =          QUADRANT$NUM=2;
           =      ELSE
454   3  =      IF (Y>=128) AND (Y<=255) THEN
455   3  =          QUADRANT$NUM=6;
           =      ELSE
456   3  =      IF (Y>=256) AND (Y<=383) THEN
457   3  =          QUADRANT$NUM=10;
           =      ELSE
458   3  =      IF (Y>=384) AND (Y<=511) THEN
459   3  =          QUADRANT$NUM=14;
           =    END;
           =    ELSE
           =
461   2  =    IF (X>=256) AND (X<=383) THEN
462   2  =    DO;
```

```
463   3  =      IF (Y>=0) AND (Y<=127) THEN
464   3  =          QUADRANT$NUM=3;
           =      ELSE
465   3  =      IF (Y>=128) AND (Y<=255) THEN
466   3  =          QUADRANT$NUM=7;
           =      ELSE
467   3  =      IF (Y>=256) AND (Y<=383) THEN
468   3  =          QUADRANT$NUM=11;
           =      ELSE
469   3  =      IF (Y>=384) AND (Y<=511) THEN
470   3  =          QUADRANT$NUM=15;
           =    END;
           =    ELSE
           =
472   2  =    IF (X>=384) AND (X<=511) THEN
473   2  =    DO;
474   3  =      IF (Y>=0) AND (Y<=127) THEN
475   3  =          QUADRANT$NUM=4;
           =      ELSE
476   3  =      IF (Y>=128) AND (Y<=255) THEN
477   3  =          QUADRANT$NUM=8;
```

```
                =       ELSE
 478    3       =       IF (Y>=256) AND (Y<=383) THEN
 479    3       =           QUADRANT$NUM=12;
                =       ELSE
 480    3       =       IF (Y>=384) AND (Y<=511) THEN
 481    3       =           QUADRANT$NUM=16;
                =     END;
                =
                =     RETURN QUADRANT$NUM ;
 484    2       =     END; /* QUAD$NUM */



 485    1             INITIALIZE$GRAPHICS: PROCEDURE PUBLIC;

                      /* THIS PROCEDURE INITIALIZES PARAMETERS FOR GRAPH MOD
ULE */
 486    2             JSPECIAL = 100;
 487    2             BACKUP$SHIP$COUNT = 0;
 488    2             CALL INITIALIZE$PLASMA;
 489    2             CALL CLEAR$PLASMA;
```

```
490   2       CALL INITIALIZE$PLASMA$2;
491   2       CALL CLEAR$PLASMA$2;
492   2       END; /* INITIALIZE$GRAPHICS */


493   1       SEND$GRID$PLASMA: PROCEDURE PUBLIC;
494   2         CALL CLEAR$PLASMA;
495   2         CALL DRAW$GRID;
496   2       END;


497   1       SEND$GRID$PLASMA$2: PROCEDURE PUBLIC;
498   2         CALL CLEAR$PLASMA$2;
499   2         CALL DRAW$GRID$2;
500   2       END;


501   1       INITIALIZE$STRUCTURE: PROCEDURE PUBLIC;

               /* THIS A PROCEDURE TO INITIALIZE STRUCTURE TO TEST MO
DULE STAND-ALO
             -   NE. */
```

```
502   2       DCL (A0,B0,C0,D0,E0,F0,G0,H0) ADDRESS;
503   2       A0=100;
504   2       B0=200;
505   2       C0=300;
506   2       D0=400;
507   2       G0=275;
508   2       H0=350;
509   2       IF (JSPECIAL =100) THEN
510   2       DO;
511   3       F0=0;
512   3       E0=0;
513   3       END;
514   2       SHIP$PLOT(1).COUNT=2;
515   2       SHIP$PLOT(0).COUNT=3;
516   2       SHIP$PLOT(2).COUNT=1;
517   2       SHIP$PLOT(0).X$BOW(0)=A0;
518   2       SHIP$PLOT(0).X$BOW(1)=D0;
519   2       SHIP$PLOT(0).X$BOW(2)=G0;
520   2       SHIP$PLOT(1).X$BOW(0)=B0;
521   2       SHIP$PLOT(1).X$BOW(1)=H0;
522   2       SHIP$PLOT(2).X$BOW(0)=C0;
```

```
 523   2       SHIP$PLOT(0).Y$BOW(0)=479-(1*E0);
 524   2       SHIP$PLOT(0).Y$BOW(1)=351-(2*E0);
 525   2       SHIP$PLOT(0).Y$BOW(2)=447-(2*E0);
 526   2       SHIP$PLOT(1).Y$BOW(0)=479-(3*E0);
 527   2       SHIP$PLOT(1).Y$BOW(1)=447-(2*E0);
 528   2       SHIP$PLOT(2).Y$BOW(0)=479-(4*E0);
 529   2       SHIP$PLOT(0).QUADRANT(0)=QUAD$NUM(SHIP$PLOT(0).X$BOW(0
),SHIP$PLOT(0)
             -    .Y$BOW(0));
 530   2       SHIP$PLOT(0).QUADRANT(1)=QUAD$NUM(SHIP$PLOT(0).X$BOW(1
),SHIP$PLOT(0)
             -    .Y$BOW(1));
 531   2       SHIP$PLOT(0).QUADRANT(2)=QUAD$NUM(SHIP$PLOT(0).X$BOW(2
),SHIP$PLOT(0)
             -    .Y$BOW(2));
 532   2       SHIP$PLOT(1).QUADRANT(0)=QUAD$NUM(SHIP$PLOT(1).X$BOW(0
),SHIP$PLOT(1)
             -    .Y$BOW(0));
 533   2       SHIP$PLOT(1).QUADRANT(1)=QUAD$NUM(SHIP$PLOT(1).X$BOW(1
),SHIP$PLOT(1)
             -    .Y$BOW(1));
 534   2       SHIP$PLOT(2).QUADRANT(0)=QUAD$NUM(SHIP$PLOT(2).X$BOW(0
),SHIP$PLOT(2)
             -    .Y$BOW(0));
 535   2        E0=E0+1;
 536   2       JSPECIAL=JSPECIAL+1;
 537   2       END; /* INITIALIZE$STRUCTURE */
```

```
538   1       DRAW$SHIP$DASH: PROCEDURE (A1) PUBLIC;

                  /*  THIS PROCEDURE DRAWS DASHED SHIPS IN THE PLASMA
DISPLAY
                       (DEVICE ONE). */
539   2       DCL (A1,SHIPINDEX,INDEX) BYTE ;
540   2       INDEX=0;
541   2       SHIPINDEX=0;
542   2       DO WHILE INDEX < 3 ;
543   3         IF (SHIP$PLOT(INDEX + A1).COUNT) > 0 THEN
544   3            DO WHILE SHIPINDEX < SHIP$PLOT(INDEX + A1).COUNT
;
545   4              IF INDEX = 0 THEN
546   4                CALL DRAW$FRIEND$DASH(
                         SHIP$PLOT(INDEX + A1).X$BOW(SHIPINDEX),
                         SHIP$PLOT(INDEX + A1).Y$BOW(SHIPINDEX),1);
                       ELSE
547   4                IF INDEX = 1 THEN
548   4                  CALL DRAW$HOSTILE$DASH(
                         SHIP$PLOT(INDEX + A1).X$BOW(SHIPINDEX),
                         SHIP$PLOT(INDEX + A1).Y$BOW(SHIPINDEX),1);
```

```
                    ELSE
 549   4            IF INDEX = 2 THEN
 550   4              CALL DRAW$UNKNOWN$DASH(
                       SHIP$PLOT(INDEX + A1).X$BOW(SHIPINDEX),
                       SHIP$PLOT(INDEX + A1).Y$BOW(SHIPINDEX),1);
                    SHIPINDEX=SHIPINDEX + 1;
                  /*  AD ANNOTATION ROUTINE  ****************/
 552   4            END; /* DO WHILE SHIPINDEX **/
 553   3          SHIPINDEX = 0;
 554   3          INDEX = INDEX + 1;
 555   3        END; /* DO WHILE INDEX < 3 */
 556   2        END; /* DRAW$SHIP$DASH */


 557   1        DRAW$SHIP$DASH$LOOP: PROCEDURE (A2) PUBLIC;

                    /* THIS PROCEDURE DRAWS BACKUP DASH SHIP POSITIONS
*/
 558   2        DCL (A2,B2,C2) BYTE ;
 559   2        C2 = 0 ;
 560   2        DO B2 = 1 TO A2 ;
 561   3          CALL DRAW$SHIP$DASH (3 + C2);
```

```
 562   3          C2=C2 + 3;
 563   3        END; /* DO B2 */
 564   2        END; /* DRAW$SHIP$DASH$LOOP */


 565   1        STRUCTURE$BACK: PROCEDURE (A3) PUBLIC;

                  /* THIS PROCEDURE TRANSFERS SHIP STRUCTURE SET (3) T
O NEXT
                     ADJACENT BACKUP SHIP STRUCTURE SET.    */
 566   2        DCL (A3,B,C,D,E) BYTE;
 567   2        B=A3 + 2;
 568   2        E=A3 + 3;
 569   2        DO C = A3 TO B;
 570   3          SHIP$PLOT(E).COUNT = SHIP$PLOT(C).COUNT;
 571   3          IF SHIP$PLOT(E).COUNT > 0 THEN
 572   3            DO D = 0 TO (SHIP$PLOT(E).COUNT-1);
 573   4              SHIP$PLOT(E).LAT(D)=SHIP$PLOT(C).LAT(D);
 574   4              SHIP$PLOT(E).LONG(D)=SHIP$PLOT(C).LONG(D);
 575   4              SHIP$PLOT(E).COURSE(D)=SHIP$PLOT(C).COURSE(D);
 576   4              SHIP$PLOT(E).SPEED(D)=SHIP$PLOT(C).SPEED(D);
 577   4              SHIP$PLOT(E).X$BOW(D)=SHIP$PLOT(C).X$BOW(D);
```

```
 578   4            SHIP$PLOT(E).Y$BOW(D)=SHIP$PLOT(C).Y$BOW(D);
 579   4            SHIP$PLOT(E).QUADRANT(D)=SHIP$PLOT(C).QUADRANT(D)
;
 580   4            SHIP$PLOT(E).RANGE(D)=SHIP$PLOT(C).RANGE(D);
 581   4            SHIP$PLOT(E).BEARING(D)=SHIP$PLOT(C).BEARING(D);
 582   4            SHIP$PLOT(E).COLLISION$FLAG(D)=SHIP$PLOT(C).COLLI
SION$FLAG(D);
 583   4            SHIP$PLOT(E).CPA$TIME(D)=SHIP$PLOT(C).CPA$TIME(D)
;
 584   4            SHIP$PLOT(E).CPA$DISTANCE(D)=SHIP$PLOT(C).CPA$DIS
TANCE(D);
 585   4          END;
               /* DO D=1 TO SHIP$PLOT */
 586   3          E=E + 1;
 587   3       END; /* DO C = A3 TO B */
 588   2       END; /* STRUCTURE$BACK */


 589   1       BACKUPS: PROCEDURE (A4) PUBLIC;

               /* THIS PROCEDURE TRANSFERS BACKUP STRUCTURES IN FIFO
QUEUE. */
 590   2       DCL (A4,B4,C4) BYTE;
 591   2       BACKUP$SHIP$COUNT=BACKUP$SHIP$COUNT + 1;
 592   2       IF BACKUP$SHIP$COUNT = 5 THEN
 593   2         DO ;
```

```
                    /* WRITE ALL SHIP STRUCTUTES TO DISK .  *********
*********/
 594   3              BACKUP$SHIP$COUNT=0;
 595   3            END; /* END IF */
 596   2          DO CASE A4-1;
 597   3            B4=0;
 598   3            B4=3;
 599   3            B4=6;
 600   3            B4=9;
 601   3          END; /* CASE A4 */
 602   2          DO C4 = 1 TO A4;
 603   3            CALL STRUCTURE$BACK(B4);
 604   3            B4 = B4 - 3;
 605   3          END; /* DO C4 = 1 TO A4 */
 606   2          END; /* BACKUPS */


 607   1          DRAW$SHIP:PROCEDURE (TAIL) PUBLIC;

                    /*THIS PROCEDURE DRAW SHIPS IN THE PLASMA DISPLAY (DEV
ICE ONE) */
 608   2          DCL (A,TAIL) BYTE;
 609   2          DCL (X1,Y1,X2,Y2,B,C) ADDRESS;
```

```
610   2       DCL (ZINDEX,ZSHIPINDEX) BYTE;
611   2       ZINDEX=0;
612   2       ZSHIPINDEX=0;
613   2       DO WHILE ZINDEX <3 ;
614   3         IF (SHIP$PLOT(ZINDEX).COUNT) >  0 THEN
615   3           DO WHILE ZSHIPINDEX < SHIP$PLOT(ZINDEX).COUNT;
616   4             IF ZINDEX=0 THEN
617   4               CALL DRAW$FRIEND$SYMBOL(
                        SHIP$PLOT(0).X$BOW(ZSHIPINDEX),
                        SHIP$PLOT(0).Y$BOW(ZSHIPINDEX),1);
                    ELSE
618   4               IF ZINDEX=1 THEN
619   4                 CALL DRAW$HOSTILE$SYMBOL(
                          SHIP$PLOT(1).X$BOW(ZSHIPINDEX),
                          SHIP$PLOT(1).Y$BOW(ZSHIPINDEX),1);
                    ELSE
620   4               IF ZINDEX=2 THEN
621   4                 CALL DRAW$UNKNOWN$SYMBOL(
                          SHIP$PLOT(2).X$BOW(ZSHIPINDEX),
                          SHIP$PLOT(2).Y$BOW(ZSHIPINDEX),1);
```

```
                /* DRAW TAIL FOR SHIP */
                   IF TAIL THEN
 623   4               DO;
 624   5               X1 = SHIP$PLOT(ZINDEX).X$BOW(ZSHIPINDEX);
 625   5               Y1 = SHIP$PLOT(ZINDEX).Y$BOW(ZSHIPINDEX);
 626   5               IF NOT ((X1<7) OR (X1>504) OR (Y1<7) OR (Y1>504)
) THEN
 627   5               IF SHIP$PLOT(ZINDEX+3).COUNT > 0 THEN
 628   5                  DO;
 629   6                  IF SHIP$PLOT(ZINDEX+6).COUNT <= 0 THEN A=3;
 631   6                  ELSE IF SHIP$PLOT(ZINDEX+9).COUNT <= 0 THEN A
=6;
 633   6                       ELSE IF SHIP$PLOT(ZINDEX+12).COUNT <= 0
THEN A=9;
 635   6                            ELSE A=12;
 636   6                  X2 = SHIP$PLOT(ZINDEX+A).X$BOW(ZSHIPINDEX);
 637   6                  Y2 = SHIP$PLOT(ZINDEX+A).Y$BOW(ZSHIPINDEX);
 638   6                  B = X1 + (X2-X1) + (X2-X1) + (X2-X1);
 639   6                  C = Y1 + (Y2-Y1) + (Y2-Y1) + (Y2-Y1);
 640   6                  CALL START$VECTOR$SOLID(X1,Y1);
 641   6                  CALL STOP$VECTOR$SOLID(B,C);
 642   6                  END; /* IF SHIP$PLOT(ZINDEX+3 */
```

```
 643   5            END; /*IF TAIL */



 644   4       X1=SHIP$PLOT(ZINDEX).X$BOW(ZSHIPINDEX);
 645   4       Y1=SHIP$PLOT(ZINDEX).Y$BOW(ZSHIPINDEX);
 646   4       IF((X1>=7) OR (X1<=504) OR (Y1>=7) OR (Y1<=504)) THEN
 647   4       DO;
                /* WRITE CONTACT ID NEXT TO SYMBOL */
 648   5            IF (SHIP$PLOT(ZINDEX).X$BOW(ZSHIPINDEX) <= 486)
THEN
 649   5              CALL WRITE$CONTACT$ID(SHIP$PLOT(ZINDEX).X$BOW
(ZSHIPINDEX)+1
           -   1,
                         SHIP$PLOT(ZINDEX).Y$BOW(ZSHIPINDEX)+8,ZS
HIPINDEX);
           -
                     ELSE
 650   5              CALL WRITE$CONTACT$ID(SHIP$PLOT(ZINDEX).X$BOW
(ZSHIPINDEX)-1
           -   8,
                         SHIP$PLOT(ZINDEX).Y$BOW(ZSHIPINDEX)+8,ZS
HIPINDEX);
```

```
 651   5       END;
 652   4            ZSHIPINDEX=ZSHIPINDEX+1;
 653   4          END; /* DO WHILE ZSHIPINDEX */
 654   3       ZSHIPINDEX=0;
 655   3       ZINDEX=ZINDEX+1;
 656   3       END; /* DO WHILE ZINDEX < 3 */
 657   2       END; /* DRAW$SHIP */


               $INCLUDE(:F1:GRAPH2.SRC)
           =
           =
           =   /* THIS MODULE CONTAINS PROCEDURES TO DRAW SYMBOLS TO
THE
           =        PLASMA DEVICE TWO */
           =
           =   /* GRAPH2$MODULE: */
 658   1 =   DRAW$SHIP$DASH$2: PROCEDURE (A1) PUBLIC;
           =
           =      /*  THIS PROCEDURE DRAWS DASHED SHIPS IN THE PLASMA
 DISPLAY
           =           (DEVICE TWO). */
 659   2 =   DCL (A1,SHIPINDEX,INDEX) BYTE ;
```

```
 660   2  =   INDEX=0;
 661   2  =   SHIPINDEX=0;
 662   2  =   DO WHILE INDEX < 3 ;
 663   3  =     IF (SHIP$PLOT(INDEX + A1).COUNT) > 0 THEN
 664   3  =        DO WHILE SHIPINDEX < SHIP$PLOT(INDEX + A1).COUNT
;
 665   4  =          IF INDEX = 0 THEN
 666   4  =            CALL DRAW$FRIEND$DASH$2(
            =             SHIP$PLOT(INDEX + A1).X$BOW(SHIPINDEX),
            =             SHIP$PLOT(INDEX + A1).Y$BOW(SHIPINDEX),1);
            =          ELSE
 667   4  =          IF INDEX = 1 THEN
 668   4  =            CALL DRAW$HOSTILE$DASH$2(
            =             SHIP$PLOT(INDEX + A1).X$BOW(SHIPINDEX),
            =             SHIP$PLOT(INDEX + A1).Y$BOW(SHIPINDEX),1);
            =          ELSE
 669   4  =          IF INDEX = 2 THEN
 670   4  =            CALL DRAW$UNKNOWN$DASH$2(
            =             SHIP$PLOT(INDEX + A1).X$BOW(SHIPINDEX),
            =             SHIP$PLOT(INDEX + A1).Y$BOW(SHIPINDEX),1);
            =          SHIPINDEX=SHIPINDEX + 1;
 672   4  =        END; /* DO WHILE SHIPINDEX **/
```

```
 673   3  =       SHIPINDEX = 0;
 674   3  =       INDEX = INDEX + 1;
 675   3  =    END; /* DO WHILE INDEX < 3 */
 676   2  =    END; /* DRAW$SHIP$DASH$2 */
            =
            =
 677   1  =    DRAW$SHIP$DASH$LOOP$2: PROCEDURE (A2) PUBLIC;
            =
            =       /* THIS PROCEDURE DRAWS BACKUP DASH SHIP POSITIONS
*/
 678   2  =    DCL (A2,B2,C2) BYTE ;
 679   2  =    C2 = 0 ;
 680   2  =    DO B2 = 1 TO A2 ;
 681   3  =      CALL DRAW$SHIP$DASH$2 (3 + C2);
 682   3  =      C2=C2 + 3;
 683   3  =    END; /* DO B2 */
 684   2  =    END; /* DRAW$SHIP$DASH$LOOP$2 */
            =
            =
 685   1  =    DRAW$SHIP$2:PROCEDURE (TAIL) PUBLIC;
            =
            =    /*THIS PROCEDURE DRAW SHIPS IN THE PLASMA DISPLAY (DEV
ICE TWO) */
```

```
686   2  =    DCL (A,TAIL) BYTE;
687   2  =    DCL (X1,Y1,X2,Y2,B,C) ADDRESS;
688   2  =    DCL (ZINDEX,ZSHIPINDEX) BYTE;
689   2  =    ZINDEX=0;
690   2  =    ZSHIPINDEX=0;
691   2  =    DO WHILE ZINDEX <3 ;
692   3  =      IF (SHIP$PLOT(ZINDEX).COUNT) >  0 THEN
693   3  =        DO WHILE ZSHIPINDEX < SHIP$PLOT(ZINDEX).COUNT;
694   4  =          IF ZINDEX=0 THEN
695   4  =            CALL DRAW$FRIEND$SYMBOL$2(
      =              SHIP$PLOT(0).X$BOW(ZSHIPINDEX),
      =              SHIP$PLOT(0).Y$BOW(ZSHIPINDEX),1);
      =          ELSE
696   4  =          IF ZINDEX=1 THEN
697   4  =            CALL DRAW$HOSTILE$SYMBOL$2(
      =              SHIP$PLOT(1).X$BOW(ZSHIPINDEX),
      =              SHIP$PLOT(1).Y$BOW(ZSHIPINDEX),1);
      =          ELSE
698   4  =          IF ZINDEX=2 THEN
699   4  =            CALL DRAW$UNKNOWN$SYMBOL$2(
      =              SHIP$PLOT(2).X$BOW(ZSHIPINDEX),
```

```
                =              SHIP$PLOT(2).Y$BOW(ZSHIPINDEX),1);
                =
                =
                =
                =
                =
                =     /* DRAW TAIL FOR SHIP */
                =     IF TAIL THEN
 701    4       =        DO;
 702    5       =        X1=SHIP$PLOT(ZINDEX).X$BOW(ZSHIPINDEX);
 703    5       =        Y1=SHIP$PLOT(ZINDEX).Y$BOW(ZSHIPINDEX);
 704    5       =        IF NOT (( X1<7) OR (X1>504) OR (Y1<7) OR (Y1>504))
THEN
 705    5       =        IF SHIP$PLOT(ZINDEX+3).COUNT > 0 THEN
 706    5       =           DO;
 707    6       =           IF SHIP$PLOT(ZINDEX+6).COUNT <=0 THEN A=3;
 709    6       =           ELSE IF SHIP$PLCT(ZINDEX+9).COUNT <=0 THEN A=6;
 711    6       =           ELSE IF SHIP$PLOT(ZINDEX+12).COUNT <=0 THEN A=9;
 713    6       =                      ELSE A=12;
 714    6       =           X2=SHIP$PLOT(ZINDEX+A).X$BOW(ZSHIPINDEX);
 715    6       =           Y2=SHIP$PLOT(ZINDEX+A).Y$BOW(ZSHIPINDEX);
 716    6       =           B=X1 + (X2-X1) + (X2-X1) + (X2-X1);
```

```
 717   6  =          C=Y1 + (Y2-Y1) + (Y2-Y1) + (Y2-Y1);
 718   6  =          CALL START$VECTOR$SOLID$2(X1,Y1);
 719   6  =          CALL STOP$VECTOR$SOLID$2(B,C);
 720   6  =          END; /* IF SHIP$PLOT(ZINDEX+3 */
 721   5  =       END; /* IF TAIL */
            =
            =
            =
            =
            =
            =     /* LABEL CONTACT SYMBOL */
            =
 722   4  =    IF SHIP$PLOT(ZINDEX).X$BOW(ZSHIPINDEX)<=486 THEN
 723   4  =       CALL WRITE$CONTACT$ID$2(SHIP$PLOT(ZINDEX).X$BOW(ZSH
IPINDEX)+11,
            =            SHIP$PLOT(ZINDEX).Y$BOW(ZSHIPINDEX)+8,ZSHIPIND
EX);
            =    ELSE
 724   4  =       CALL WRITE$CONTACT$ID$2(SHIP$PLOT(ZINDEX).X$BOW(ZSH
IPINDEX)-18,
            =            SHIP$PLOT(ZINDEX).Y$BOW(ZSHIPINDEX)+8,ZSHIPIND
EX);
            =
 725   4  =         ZSHIPINDEX=ZSHIPINDEX+1;
 726   4  =        END; /* DO WHILE ZSHIPINDEX */
```

```
 727   3  =    ZSHIPINDEX=0;
 728   3  =    ZINDEX=ZINDEX+1;
 729   3  =    END; /* DO WHILE ZINDEX < 3 */
 730   2  =    END; /* DRAW$SHIP$2 */
            =
            =    /* END; GRAPH2$MODULE */


 731   1       END; /* GRAPH1 MODULE */
```


MODULE INFORMATION:

```
     CODE AREA SIZE      = 194FH   6479D
     VARIABLE AREA SIZE  = 0D8BH   3467D
     MAXIMUM STACK SIZE  = 0008H      8D
     1233 LINES READ
     0 PROGRAM ERROR(S)
```

END OF PL/M-80 COMPILATION

```
ISIS-II PL/M-80 V3.1 COMPILATION OF MODULE PDPMODULE
NO OBJECT MODULE REQUESTED
COMPILER INVOKED BY:  PLM80 :F1:PDP.MOD NOOBJECT PAGEWIDTH(82) PAGEL
ENGTH(24) DATE
                  -(MAY 1979) TITLE('MODULE PDP.MOD')



   1          PDP$MODULE:
              DO;


              $INCLUDE(:F1:MP.DEC)
         =
         =        /*  DECLARATIONS: ************/
         =
   2   1  =        DECLARE LIT LITERALLY 'LITERALLY';
   3   1  =        DECLARE DCL LIT 'DECLARE';
         =
         =
```

```
                =       /*  ISIS-II SYSTEM CONSTANTS **/
                =
  4   1         =       DCL  TOP  LIT '0F800H'; /* TOP OF FREE SPACE */
  5   1         =       DCL  BASE LIT '0F000H';/* BASE OF PDP BUFFER */
  6   1         =   DCL RECEIVE$PRINT BYTE EXTERNAL;
                =
                =
                =
                =
                =
                =       /* PROGRAM CONSTANTS: ******/
                =
                =
  7   1         =       DCL     TRUE      LIT     '0FFH';
  8   1         =       DCL     FALSE     LIT     '000H';
  9   1         =       DCL     FOREVER   LIT     'WHILE 1';
 10   1         =       DCL     RCVD      LIT     '2EH';
 11   1         =       DCL     NEUTRAL   LIT     '0';
 12   1         =       DCL     RECEIVE   LIT     '1';
 13   1         =       DCL     TRANSMIT  LIT     '2';
 14   1         =       DCL     ACK       LIT     '06H';
```

```
 15   1  =        DCL     READ$ACCESS  LIT  '1';
 16   1  =        DCL     END$OF$BLOCK LIT '0FFFFH';
           =
           =
           =
           =
           =
           =        /* GLOBAL VARIABLES: *********/
           =
           =
 17   1  =            DCL PDP$BUFFER (2000) BYTE PUBLIC ;
 18   1  =        DCL CRT$BUFFER (200) BYTE;
 19   1  =        DCL FILE$NAME (*) BYTE INITIAL ('F1:TFILE1.ONE
   ');
 20   1  =        DCL ( PDP$BUF$FIRST,
           =              PDP$BUF$LAST,
           =              PDP$BUF$NUMBER,
           =              CRT$BUF$FIRST,
           =              CRT$BUF$LAST,
           =              CRT$BUF$NUMBER,
           =              LENGTH$PDP$BUF,
           =              LAST$LOC$PDP$BUF,
```

```
            =               WRITE$STATUS,
            =               DELETE$STATUS,
            =               READ$STATUS,
            =               OPEN$STATUS,
            =               PDP$BUF$PTR,
            =               CLOSE$STATUS,
            =               CONSOL$STATUS,
            =               BYTE$COUNT,
            =               COUNT$TEMP,
            =               AFT$IN ) ADDRESS ;
 21   1     =       DCL ( MISSINGDATA,
            =               STOP$FLAG,
            =               SENT$ACK,
            =               ALARM,
            =               D1,D2,D3,
            =               CHAR$TWO,
            =               CHAR,
            =               STATE,
            =               PREVCHAR,
            =               EOFILE,
            =               SKIP$FIVE,
```

```
          =              ECHOCHAR,
          =              SAVECHAR ) BYTE ;
  22   1  =        DCL   CRTECHO BYTE INITIAL (0);
  23   1  =        DCL   PDPECHO BYTE INITIAL (0);
          =
          =
          =
          =
          =           /*  SPECIAL CHARACTERS: ********/
          =
          =
  24   1  =        DCL  RUBOUT     LIT '7FH',
          =             PROMPT     LIT '25H',  /*  PERCENT */
          =             CONTROL$W  LIT '17H',
          =             CONTROL$N  LIT '4EH',
          =             CONTROL$R  LIT '12H',
          =             CONTROL$T  LIT '14H',
          =             CONTROL$Z  LIT '1AH',
          =             CONTROL$C  LIT '03H',
          =             CR         LIT '0DH',
          =             LF         LIT '0AH',
```

```
                =           BELL      LIT '07H';
                =
                =
                =
                =
                =
                =       /*ISIS-II SYSTEM CALLS: **********/
                =
                =
  25    1       =       OPEN:
                =           PROCEDURE (AFT,FILE,ACCESS,MODE,STATUS ) EXTER
NAL;
  26    2       =                   DECLARE (AFT,FILE,ACCESS,MODE,STATUS )AD
DRESS;
  27    2       =       END OPEN;
                =
                =
  28    1       =       CLOSE:
                =            PROCEDURE(AFT,STATUS) EXTERNAL;
  29    2       =                 DCL (AFT,STATUS) ADDRESS;
  30    2       =       END CLOSE;
                =
                =
```

```
  31   1  =       READ:
          =           PROCEDURE(AFT,BUFFER,COUNT,ACTUAL,STATUS) EXTE
RNAL;
  32   2  =             DCL(AFT,BUFFER,COUNT,ACTUAL,STATUS) ADDRESS;
  33   2  =       END READ;
          =
          =
  34   1  =       WRITE:
          =            PROCEDURE(AFT,BUFFER,COUNT,STATUS) EXTERNAL;
  35   2  =              DCL(AFT,BUFFER,COUNT,STATUS) ADDRESS;
  36   2  =       END WRITE;
          =
          =
          =
  37   1  =       EXIT:
          =           PROCEDURE EXTERNAL;
  38   2  =             DCL STATUS ADDRESS;
  39   2  =       END EXIT;
          =
          =
          =
  40   1  =       CONSOL:
```

```
        =           PROCEDURE(INFILE,OUTFILE,STATUS) EXTERNAL;
41   2  =                 DCL (INFILE,OUTFILE,STATUS) ADDRESS;
42   2  =       END CONSOL;
        =
        =
        =
43   1  =       DELETE:
        =             PROCEDURE(FILE,STATUS) EXTERNAL;
44   2  =               DCL(FILE,STATUS) ADDRESS;
45   2  =       END DELETE;
        =
        =
        =
46   1  =       ERROR:
        =            PROCEDURE (ERRNUM) EXTERNAL;
47   2  =              DCL (ERRNUM) ADDRESS;
48   2  =       END ERROR;
        =
        =
49   1  =       RENAME:
        =             PROCEDURE(OLDFILE,NEWFILE,STATUS) EXTERNAL;
```

```
 50   2  =              DCL(OLDFILE,NEWFILE,STATUS) ADDRESS;
 51   2  =      END RENAME;
           =
           =
           =
           =
           =
           =
           =
           =
           =      /*  PROCEDURES:***************/
           =
           =
           =
 52   1  =          SET$TTY$2400: PROCEDURE;
           =
           =            /* SET TTY BAUD RATE TO 2400 */
 53   2  =               OUTPUT(245)=40H;
 54   2  =               OUTPUT(245)=4FH;
 55   2  =               OUTPUT(245)=37H;
 56   2  =             END;
```

```
                =
                =
                =
 57    1        =        OUTPUT$STATUS$CRT: PROCEDURE BYTE;
                =
                =        /* TRUE IF DATA OUTPUT LINE TO CRT READY */
 58    2        =           RETURN ROR (INPUT(247),2);
 59    2        =        END;
                =
                =
                =
                =
                =
 60    1        =        OUTPUT$STATUS$PDP: PROCEDURE BYTE;
                =
                =        /* TRUE IF DATA OUTPUT LINE TO PDP READY */
 61    2        =           RETURN ROR(INPUT(245),2);
 62    2        =        END;
                =
                =
                =
```

```
 63   1  =       INPUT$STATUS$CRT: PROCEDURE BYTE;
             =
             =         /* TRUE IF DATA INPUT LINE FROM CRT READY */
 64   2  =         RETURN ROR(INPUT(247),1);
 65   2  =       END;
             =
             =
             =
 66   1  =       INPUT$STATUS$PDP: PROCEDURE BYTE ;
             =
             =       /* TRUE IF DATA INPUT LINE FROM PDP READY */
 67   2  =         RETURN ROR(INPUT(245),1) ;
 68   2  =       END;
             =
             =
             =
 69   1  =       SEND$CHAR$CRT: PROCEDURE (CHAR) ;
             =
             =       /* PRINT A CHARACTER TO THE CRT */
 70   2  =         DCL CHAR BYTE;
 71   2  =           DO WHILE NOT OUTPUT$STATUS$CRT;
```

```
  72   3  =            END;
  73   2  =            OUTPUT(246)= CHAR;
  74   2  =       END;
          =
          =
          =
  75   1  =       SEND$CHAR$PDP: PROCEDURE (CHAR);
          =
          =       /* SEND A CHARACTER TO THE PDP */
  76   2  =          DCL CHAR BYTE;
  77   2  =            DO WHILE NOT OUTPUT$STATUS$PDP;
  78   3  =            END;
  79   2  =            OUTPUT(244)= CHAR;
  80   2  =       END;
          =
          =
          =
          =           /* CRLF: */
  81   1  =       CRLF: PROCEDURE ;
          =
          =       /* SEND CARRIAGE RETURN AND LINE FEED TO THE CRT *
/
```

```
 82   2  =          CALL SEND$CHAR$CRT(CR);
 83   2  =          CALL SEND$CHAR$CRT(LF);
 84   2  =       END;
           =
           =
           =
 85   1  =       SEND$STRING$CRT: PROCEDURE (STRING$ADDRESS);
           =
           =       /* SEND MESSAGE AT STRING$ADDRESS UNTIL '$' IS
           =          DETECTED */
 86   2  =          DCL STRING$ADDRESS ADDRESS;
 87   2  =          DCL TEMPCHAR BASED STRING$ADDRESS BYTE;
 88   2  =          DO WHILE TEMPCHAR <> '$';
 89   3  =          CALL SEND$CHAR$CRT(TEMPCHAR);
 90   3  =          STRING$ADDRESS=STRING$ADDRESS + 1;
 91   3  =          END;
 92   2  =       END;
           =
           =
           =
 93   1  =       PRINT$TO$CRT: PROCEDURE (STRING$ADDRESS) ;
```

```
                =
                =       /* PRINT A STRING TO THE CRT */
 94    2        =          DCL STRING$ADDRESS ADDRESS;
 95    2        =           CALL CRLF;
 96    2        =           CALL SEND$STRING$CRT(STRING$ADDRESS);
 97    2        =           CALL CRLF;
 98    2        =       END;
                =
                =
                =
 99    1        =       READ$CRT$CHAR: PROCEDURE BYTE;
                =       /* READ A CHARACTER FROM THE CRT */
100    2        =          DCL CHAR BYTE;
101    2        =          CHAR= INPUT(246) AND 07FH;
102    2        =          IF CRTECHO OR (STATE=RECEIVE) THEN
103    2        =          CALL SEND$CHAR$CRT(CHAR);
104    2        =          RETURN CHAR;
105    2        =       END;
                =
                =
                =
```

```
 106   1   =       READ$CHAR$PDP:PROCEDURE BYTE;
               =
               =       /* READ A CHARACTER FROM THE PDP */
 107   2   =          DCL CHAR BYTE;
 108   2   =          CHAR= INPUT (244) ;
 109   2   =          RETURN CHAR;
 110   2   =       END;
               =
               =
               =
 111   1   =       GET$CHAR$CRT$BUF: PROCEDURE BYTE;
               =
               =       /* GET A CHARACTER FROM THE CRT BUFFER */
 112   2   =          DCL CHAR BYTE;
               =          /* GET FIRST CHARACTER  */
 113   2   =          CHAR =CRT$BUFFER(CRT$BUF$FIRST);
 114   2   =          IF (CRT$BUF$FIRST:=CRT$BUF$FIRST+1)>LAST(CRT$BU
FFER)
               =          THEN CRT$BUF$FIRST=0;/* WRAP AROUND */
 116   2   =          CRT$BUF$NUMBER=CRT$BUF$NUMBER - 1;
 117   2   =          RETURN CHAR;
 118   2   =       END;
```

```
          =
          =
          =
 119   1  =       GET$CHAR$PDP$BUF: PROCEDURE BYTE;
          =
          =       /* GET A CHAR FROM THE PDP BUFFER */
 120   2  =          DCL CHAR BYTE;
          =          /* GET FIRST CHARACTER */
 121   2  =          CHAR=PDP$BUFFER(PDP$BUF$FIRST);
 122   2  =          IF (PDP$BUF$FIRST:=PDP$BUF$FIRST + 1)>LAST$LOC$
PDP$BUF
          =          THEN PDP$BUF$FIRST=0;
 124   2  =          PDP$BUF$NUMBER=PDP$BUF$NUMBER - 1;
 125   2  =          RETURN CHAR;
 126   2  =       END;
          =
          =
          =
 127   1  =       PUT$CHAR$CRT$BUF: PROCEDURE (CHAR);
          =
          =       /* A CHAR IS PUT IN THE CRT BUFFER */
 128   2  =          DCL CHAR BYTE;
```

```
 129   2  =          IF(CRT$BUF$LAST:=CRT$BUF$LAST + 1)> LAST(CRT$BU
FFER)
           =          THEN CRT$BUF$LAST=0;
 131   2  =          IF CRT$BUF$NUMBER= 0 THEN
 132   2  =             CRT$BUF$LAST=CRT$BUF$FIRST;
 133   2  =          CRT$BUFFER(CRT$BUF$LAST)=CHAR;
 134   2  =          CRT$BUF$NUMBER=CRT$BUF$NUMBER+1;
 135   2  =          ALARM=0; /* SET FOR NO ALARM FOR NEXT PASS */
 136   2  =       END;
           =
           =
           =
 137   1  =       PUT$CHAR$PDP$BUF: PROCEDURE(CHAR);
           =
           =       /* PUT CHARACTER IN PDP BUFFER */
 138   2  =       DCL CHAR BYTE;
 139   2  =         IF(PDP$BUF$LAST:=PDP$BUF$LAST + 1)>LAST$LOC$PDP$
BUF
           =           THEN PDP$BUF$LAST=0;
 141   2  =          IF(PDP$BUF$NUMBER=0)THEN
 142   2  =            PDP$BUF$LAST=PDP$BUF$FIRST;
 143   2  =         PDP$BUFFER(PDP$BUF$LAST)=CHAR;
 144   2  =         PDP$BUF$NUMBER=PDP$BUF$NUMBER+1;
```

```
145   2  =        END;
         =
         =
         =
146   1  =        CRT$BUF$FULL: PROCEDURE BYTE;
         =
         =        /* CHECK IF CRT BUFFER OVERFLOW */
147   2  =             RETURN CRT$BUF$NUMBER=LENGTH(CRT$BUFFER);
148   2  =        END;
         =
         =
         =
149   1  =        PDP$BUF$FULL: PROCEDURE BYTE;
         =
         =        /* CHECK FOR PDP BUFFER OVERFLOW */
150   2  =             RETURN PDP$BUF$NUMBER=LENGTH$PDP$BUF;
151   2  =        END;
         =
         =
         =
152   1  =        PRINT$HEX$NUMBER: PROCEDURE (CHAR);
```

```
                =
                =       /* PRINT HEXADECIMAL COUNTER */
 153    2       =          DCL CHAR BYTE;
 154    2       =          IF CHAR>9 THEN CALL SEND$CHAR$CRT(CHAR-10+'A');
 156    2       =             ELSE CALL SEND$CHAR$CRT(CHAR+'0');
 157    2       =       END;
                =
                =
                =
 158    1       =       FORMAT$HEX :PROCEDURE (CHAR);
                =       /* FORMAT DECIMAL NUMBER FOR HEXADECIMAL OUTPUT */
 159    2       =          DCL CHAR BYTE;
 160    2       =           CALL PRINT$HEX$NUMBER(SHR(CHAR,4));
 161    2       =           CALL PRINT$HEX$NUMBER(CHAR AND 0FH);
 162    2       =       END;
                =
                =
                =
 163    1       =       PRINT$CHAR$COUNT: PROCEDURE ;
                =
                =       /* PRINT DECIMAL COUNTER IN HEXADECIMAL FORMAT */
```

```
164   2  =           CALL CRLF;
165   2  =           CALL SEND$STRING$CRT(.('CHARACTER COUNT:$'));
166   2  =           IF D1 <> 0 THEN CALL FORMAT$HEX(D1);
168   2  =           IF D2 <> 0 THEN CALL FORMAT$HEX(D2);
170   2  =           CALL FORMAT$HEX(D3);
171   2  =        END;
            =
            =
            =
172   1  =        INIT$CHAR$COUNT: PROCEDURE;
            =
            =        /* CLEAR DECIMAL COUNTER */
173   2  =           D3,D2,D1=0;
174   2  =        END;
            =
            =
            =
175   1  =        COUNT$CHAR: PROCEDURE ;
            =
            =        /* INCREMENT DECIMAL COUNTER */
176   2  =           D3=DEC(D3+1);
```

```
177   2  =          D2=DEC(D2 PLUS 0);
178   2  =          D1=DEC(D1 PLUS 0);
179   2  =       END;
             =
             =
             =
180   1  =       INIT$NEUTRAL$STATE: PROCEDURE;
             =
             =       /* INITIALIZE NEUTRAL STATE */
181   2  =          STATE=NEUTRAL;
182   2  =          CALL PRINT$TO$CRT(.('SYSTEM IN NEUTRAL STATE: $
'));
183   2  =          CALL CRLF;
184   2  =          CALL SEND$CHAR$PDP(CR);
185   2  =          END;
             =
             =
             =
186   1  =       INIT$RECEIVE$STATE: PROCEDURE ;
             =
             =       /* INITIALIZE RECEIVING STATE */
187   2  =         PDP$BUF$FIRST=0;
```

```
188   2  =          PDP$BUF$LAST=0;
189   2  =          PDP$BUF$NUMBER=0;
190   2  =          PREVCHAR=' ';
191   2  =          STATE=RECEIVE;
192   2  =    IF RECEIVE$PRINT=TRUE THEN
193   2  =       DO;
194   3  =          CALL SEND$STRING$CRT(.('SYSTEM IN RECEIVE STATE:
$'));
195   3  =          CALL CRLF;
196   3  =       END; /* IF RECEIVE$PRINT */
197   2  =          CALL INIT$CHAR$COUNT;
198   2  =          SKIP$FIVE = 0;
199   2  =          CALL SEND$CHAR$PDP('&');
200   2  =          CALL SEND$CHAR$PDP(CR);
201   2  =        END;
             =
             =
             =
202   1  =        INIT$TRANSMIT$STATE: PROCEDURE;
             =
             =        /* INITIALIZE TRANSMIT STATE */
203   2  =           EOFILE=0;
```

```
 204   2  =          ECHOCHAR=1;
 205   2  =          SENT$ACK = FALSE;
 206   2  =          SAVECHAR=' ';
 207   2  =          STATE=TRANSMIT;
 208   2  =          CALL PRINT$TO$CRT(.('SYSTEM IN TRANSMIT STATE:
$'));
 209   2  =          CALL CRLF;
 210   2  =          STOP$FLAG=FALSE;
 211   2  =          CALL INIT$CHAR$COUNT;
 212   2  =       END;
           =
           =
           =
 213   1  =       BREAK$STATE: PROCEDURE ;
           =
           =       /* INTERRUPT THE PDP */
 214   2  =         DCL I BYTE;
 215   2  =          DO I = 1 TO 3;
 216   3  =             CALL SEND$CHAR$PDP(RUBOUT);
 217   3  =          END;
 218   2  =       END;
           =
```

```
          =
          =
          =
 219   1  =       END$R : PROCEDURE ;
          =
          =       /* TERMINATE RECEIVE STATE ,AND RETURN TO NEUTRAL
STATE */
 220   2  =          CALL PRINT$TO$CRT(.('RECEIVE STATE TERMINATED B
Y OPERATOR.$')
            -   );
 221   2  =          CALL PRINT$TO$CRT(.('NO FILE CREATED AT FLOPPY
DISK.$'));
          =          /* DISCARD PDP BUFFER CONTENTS */
 222   2  =          PDP$BUF$FIRST=0;
 223   2  =          PDP$BUF$LAST=0;
 224   2  =          PDP$BUF$NUMBER=0;
          =       /* SEND BREAK SIGNAL TO THE PDP */
 225   2  =              CALL BREAK$STATE;
 226   2  =              CALL CLOSE(AFT$IN,.CLOSE$STATUS);
 227   2  =              CALL DELETE(.FILENAME,DELETE$STATUS);
 228   2  =       END;
          =
          =
          =
```

```
          =
 229   1  =        END$T: PROCEDURE ;
          =
          =        /* TERMINATE TRANSMIT STATE ,RETURN TO NEUTRAL STA
TE */
 230   2  =           CALL PRINT$TO$CRT(.('TRANSMIT STATE TERMINATED
BY OPERATOR.$'
          -    ));
 231   2  =           CALL PRINT$TO$CRT(.('PARTIAL FILE CREATED AT PD
P.$'));
          =           /* SEND BREAK SIGNAL TO PDP */
 232   2  =               CALL SEND$CHAR$PDP(ACK);
 233   2  =               SENT$ACK = TRUE ;
 234   2  =               CALL CLOSE (AFT$IN,.CLOSE$STATUS);
 235   2  =               CALL CONSOL (.(':CI:$'),.(':VO:$'),.CONSOL$
STATUS);
 236   2  =        END;
          =
          =
          =
          =
 237   1  =        WRITE$RECORD$TO$DISK:PROCEDURE;
          =
          =        /* WRITE ONE RECORD FROM PDPBUF TO DISK */
 238   2  =           CALL WRITE(AFT$IN,.PDP$BUFFER(PDP$BUF$PTR),128,
.WRITE$STATUS)
```

```
                -   ;
 239   2  =           CALL WRITE(0,.PDP$BUFFER(PDP$BUF$PTR),128,.WRIT
E$STATUS);
 240   2  =           PDP$BUF$PTR = PDP$BUF$PTR + 80H;
 241   2  =           IF PDP$BUF$PTR > LAST$LOC$PDP$BUF THEN
 242   2  =             DO;
 243   3  =             PDP$BUF$NUMBER = 0;
 244   3  =             END;
 245   2  =           ELSE PDP$BUF$NUMBER = PDP$BUF$NUMBER - 128;
 246   2  =         END;
            =
            =
            =
            =
 247   1  =         WRITE$PDP$BUFFER: PROCEDURE;
            =
            =         /* WRITE ENTIRE PDP BUFFER TO DISK */
 248   2  =               PDP$BUF$PTR = 0002H;
 249   2  =               PDP$BUF$NUMBER = PDP$BUF$NUMBER -3;
            =           /* PAD PDP BUFFER UNTIL PDP$BUF$NUMBER IS A MUL-
            =                TIPLE OF 128 */
 250   2  =              DO WHILE ((PDP$BUF$NUMBER - 2) AND 0177Q) <>
0;
```

```
 251   3  =              CALL PUT$CHAR$PDP$BUF(' ');
 252   3  =            END;
 253   2  =              CALL OPEN(.AFT$IN,.FILE$NAME,2,0,.OPEN$STAT
US);
 254   2  =           DO WHILE PDP$BUF$NUMBER <> 2;
       =             /* WRITE NEXT 128 BYTE RECORD TO DISK */
 255   3  =             CALL WRITE$RECORD$TO$DISK;
 256   3  =           END;
 257   2  =              CALL CLOSE (AFT$IN,.CLOSE$STATUS);
 258   2  =           PDP$BUF$PTR = 0002H;
 259   2  =           PDP$BUF$LAST,PDP$BUF$FIRST = 0;
 260   2  =        END;
       =
       =
       =
       =
       =            /* REBOOT: */
 261   1  =        REBOOT: PROCEDURE;
       =
       =        /* GO BACK TO MDS OPERATING SYSTEM : ISIS-11 */
 262   2  =           IF MISSINGDATA THEN CALL PRINT$TO$CRT(
       =    .('NEUTRAL STATE: SYSTEM MAY NOT HAVE RECEIVED ALL PDP
 CHAR TRANSMIT
```

```
            -   TED $´));
 264    2   =           CALL PRINT$TO$CRT(
            =            .(´NEUTRAL STATE AND REBOOTING TO ISIS-11 $´))
;
 265    2   =           CALL CONSOL(.(´:CI:$´),.(´:VO:$´),.CONSOL$STATU
S);
 266    2   =       END;
            =
            =

 267    1       PDP$STRUCTURE: PROCEDURE PUBLIC ;

                 /* THIS PROCEDURE IS RESPONSIBLE FOR THE MDS-PDP INTE
RFACE */
                $INCLUDE(:F1:MP.COD)
            =
            =       /* MAIN ROUTINE: ***************/
            =
            =
            =
            =
            =
            =
            =       /* BEGIN TESTING PORTS , AND SELECT THE APPROPIATE
 ACTION */
```

```
                =       /* SET THE PDP BUFFER PARAMETERS */
 268    2       =           LENGTH$PDP$BUF=2000;
 269    2       =           LAST$LOC$PDP$BUF=LENGTH$PDP$BUF-1;
                =       /* NOW,THE POINTERS OF THE BUFFERS OF THE CRT AND
THE
                =          PDP ARE INITIALIZED */
 270    2       =           PDP$BUF$FIRST,
                =           PDP$BUF$LAST,
                =           PDP$BUF$NUMBER,
                =           CRT$BUF$FIRST,
                =           CRT$BUF$LAST,
                =           CRT$BUF$NUMBER=0;
                =
                =
                =       /* INITIALIZE SYSTEM BY ENTERING THE RECEIVE STATE
 : */
                =
 271    2       =           MISSINGDATA=FALSE;
 272    2       =           ALARM=FALSE;
 273    2       =           CALL INIT$RECEIVE$STATE;
                =
                =
                =       /* BEGIN INFINITE LOOP: **********/
```

```
          =
          =
274   2   =        DO FOREVER;
          =
          =        /* FIRST CASE  INPUT FROM CRT */
          =
          =
275   3   =        IF INPUT$STATUS$CRT THEN
276   3   =         DO;  /* CRT INPUT */
          =          /* CRT BUFFER FULL */
277   4   =          IF CRT$BUF$FULL THEN
278   4   =           DO; /* SOUND ALARM ; 5 BEEPS */
279   5   =            IF NOT ALARM THEN
280   5   =             IF (ALARM:=OUTPUT$STATUS$CRT) THEN
281   5   =              DO;
282   6   =                CALL SEND$CHAR$CRT(BELL);
283   6   =                CALL SEND$CHAR$CRT(BELL);
284   6   =                CALL SEND$CHAR$CRT(BELL);
285   6   =                CALL SEND$CHAR$CRT(BELL);
286   6   =                CALL SEND$CHAR$CRT(BELL);
287   6   =              END;
```

```
 288   5  =          END; /* SOUND ALARM */
           =         ELSE /* CRT BUFFER NOT FULL */
 289   4  =          DO;
 290   5  =           CHAR=READ$CRT$CHAR;
 291   5  =            DO CASE STATE;
           =             /* NEUTRAL STATE */
 292   6  =             DO;
           =               /* CHECK FOR A COMMAND */
 293   7  =           IF CHAR =CONTROL$T THEN
 294   7  =             CALL INIT$TRANSMIT$STATE;ELSE
 295   7  =           IF CHAR=CONTROL$R THEN
 296   7  =             CALL INIT$RECEIVE$STATE; ELSE
 297   7  =           IF CHAR=CONTROL$C THEN
 298   7  =                     DO;
 299   8  =                     CALL REBOOT;
 300   8  =                     RETURN;
 301   8  =                     END;ELSE
           =           /* NOT A COMMAND */
 302   7  =           CALL PUT$CHAR$CRT$BUF(CHAR);
 303   7  =            END; /* END NEUTRAL */
           =
```

```
          =
          =
          =          /* RECEIVING STATE */
304   6   =           DO;
305   7   =             IF CHAR=CONTROL$C THEN
306   7   =                 DO;
307   8   =                  CALL END$R;
308   8   =                  CALL REBOOT;
309   8   =                  RETURN;
310   8   =                  END;
          =             ELSE /* NOT A COMMAND */
311   7   =             CALL PUT$CHAR$CRT$BUF(CHAR);
312   7   =           END; /* END RECEIVE */
          =
          =
          =
          =          /* TRANSMIT STATE */
313   6   =           DO;
          =         /* NOT A COMMAND */
314   7   =             CALL PUT$CHAR$CRT$BUF(CHAR);
315   7   =           END; /* END TRANSMIT */
```

```
 316   6  =            END; /* END CASE STATEMENT */
 317   5  =          END; /* END ELSE CRT BUFFFER NOT FULL */
 318   4  =         END; /* INPUT FROM CRT */
            =
            =
            =
            =
            =       /* SECOND CASE: INPUT FROM PDP */
 319   3  =       IF INPUT$STATUS$PDP THEN
 320   3  =        DO; /* PUT DATA IN PDP BUFFER UNLESS FULL */
 321   4  =         IF STATE=RECEIVE THEN
 322   4  =          DO; /* RECEIVING DATA  */
            =           /* PDP BUFFER FULL: GENERATE ERROR MESSAGE ,
            =              RETURN TO NEUTRAL STATE */
 323   5  =           IF PDP$BUF$FULL THEN
 324   5  =            DO;
 325   6  =                    CALL BREAK$STATE;
 326   6  =                    CALL PRINT$TO$CRT(
            =                    .('RECEIVING STATE : PDP BUFFER OVERFL
OW.$'));
 327   6  =                    CALL PRINT$TO$CRT(.('NO FILE CREATED A
T FLOPPY DISK.
              -   $'));
```

```
 328   6  =                    CALL REBOOT;
 329   6  =                    RETURN;
 330   6  =                END; /* PDP BUFFER FULL */
        =               /* BUFFER NOT FULL */
        =                /* GET CHARACTER FROM PDP */
 331   5  =                CHAR=READ$CHAR$PDP;
        =                /* PDP PROMPTING : TERMINATE RECEPTION */
 332   5  =                IF ((PREVCHAR=LF) OR (PREVCHAR=CR)) AND CHAR=
PROMPT
        =                 THEN
 333   5  =                DO; /* PROMPTING */
 334   6  =    IF RECEIVE$PRINT=TRUE THEN
 335   6  =        DO;
 336   7  =                  CALL SEND$STRING$CRT(.('PDP PROMPTING:END
OF RECEPTION.$
             -    '));
 337   7  =             CALL CRLF;
 338   7  =                   CALL SEND$STRING$CRT(
        =                      .('PDP BUFFER/FILE WRITTEN TO STRUCTUR
E.$'));
        =               /* PRINT NUMBER OF CHARACTERS TRANSMITTED
        =                  FROM PDP BUFFER TO STRUCTURE */
 339   7  =             CALL CRLF;
 340   7  =                   CALL PRINT$CHAR$COUNT;
```

```
 341   7  =                CALL SEND$STRING$CRT(
       =                .(' BYTES TRANSMITTED FROM PDP TO STRUCTU
RE.$'));
       =             /* RECEPTION COMPLETE:RETURN TO LOOP */
 342   7  =          END; /* IF RECEIVE$PRINT */
 343   6  =                RETURN;
 344   6  =             END; /* PROMPTING */
       =             ELSE
 345   5  =              IF CHAR=END$OF$BLOCK THEN
 346   5  =             DO;
 347   6  =                CALL WRITE$PDP$BUFFER;
 348   6  =                CALL PRINT$TO$CRT(
       =                .('RECEIVE STATE: RECEIVED BLOCK.$'));
       =              /* CRT ACKNOWLEDGE RECEPTION FROM PDP */
 349   6  =                CALL PUT$CHAR$CRT$BUF(RCVD);
 350   6  =                CALL PUT$CHAR$CRT$BUF(CR);
 351   6  =             END;
       =               ELSE /* NOT END OF RECEPTION-DATA */
 352   5  =             DO;
 353   6  =              PREVCHAR=CHAR;
 354   6  =              CALL PUT$CHAR$PDP$BUF(CHAR);
       =              /* INCREMENT NUMBER OF CHARS RECEIVED */
```

```
355   6  =                    IF (SKIP$FIVE < 4) THEN
356   6  =                    DO;
357   7  =                      SKIP$FIVE = SKIP$FIVE + 1;
358   7  =                    END;
       =                    ELSE
359   6  =                    DO;
360   7  =                 CALL COUNT$CHAR;
361   7  =                    END;
362   6  =              END;
363   5  =            END; /* END RECEIVING */
       =          ELSE /* NEUTRAL OR TRANSMIT STATE */
364   4  =            DO;
       =             /* PDP BUFFER FULL */
365   5  =             IF PDP$BUF$FULL THEN MISSINGDATA=1;
       =             /* BUFFER NOT FULL */
       =             ELSE
367   5  =              DO;
368   6  =                  CHAR=READ$CHAR$PDP;
369   6  =                  IF SAVECHAR=CHAR THEN ECHOCHAR=1;
371   6  =                  CALL PUT$CHAR$PDP$BUF(CHAR);
372   6  =              END;
```

```
 373   5  =          END; /* NEUTRAL OR TRNSMIT STATE */
 374   4  =        END; /*PUT DATA IN PDP BUFFER UNLESS FULL */
            =
            =
            =
            =
            =       /* THIRD CASE: SEND DATA FROM PDP TO CRT ,OR DISK
*/
 375   3  =       IF OUTPUT$STATUS$CRT THEN
            =       /* CAN SEND DATA TO CRT */
 376   3  =        DO;
 377   4  =         IF STATE<> RECEIVE THEN
 378   4  =          DO; /* CHECK IF SOMETHING FOR THE CRT */
 379   5  =           IF PDP$BUF$NUMBER > 0 THEN
 380   5  =           CALL SEND$CHAR$CRT(GET$CHAR$PDP$BUF);
 381   5  =          END;
            =         /* ELSE (RECEIVING) DATA FROM PDP TO DISK NOT TO
 CRT */
 382   4  =        END; /* CAN SEND DATA TO THE CRT */
            =
            =
            =
            =
```

```
                =
                =       /*FOURTH CASE: SEND DATA TO PDP */
 383    3       =       IF OUTPUT$STATUS$PDP THEN
 384    3       =        DO; /* SEND DATA TO PDP */
 385    4       =         IF STATE <> TRANSMIT THEN
 386    4       =          DO; /* CHECK IF CRT HAS SOMETHING FOR THE PDP *
/
 387    5       =           IF CRT$BUF$NUMBER > 0 THEN
 388    5       =           CALL SEND$CHAR$PDP(GET$CHAR$CRT$BUF);
 389    5       =          END; /* SEND DATA TO PDP */
                =         ELSE /* TRANSMITTING DATA */
 390    4       =          DO;
                =
 391    5       =                   CALL OPEN (.AFT$IN,.FILE$NAME,1,0,.OPE
N$STATUS);
 392    5       =           BYTE$COUNT=1;
 393    5       =                   CALL SEND$CHAR$PDP(CR);
 394    5       =           DO WHILE (BYTE$COUNT<>0 AND STOP$FLAG = FALSE)
;
 395    6       =                  IF INPUT$STATUS$CRT THEN
 396    6       =                    DO;
 397    7       =                    CHAR$TWO=READ$CRT$CHAR;
 398    7       =                    IF CHAR$TWO=CONTROL$C THEN
 399    7       =                      DO;
```

390

```
 400   8  =                    CALL END$T;
 401   8  =                    STOP$FLAG = TRUE;
 402   8  =                    END;
 403   7  =                  END;
 404   6  =                IF INPUT$STATUS$PDP THEN
 405   6  =                 DO;
 406   7  =                 IF (CHAR:=READ$CHAR$PDP) = '+' THEN
 407   7  =                 DO;
 408   8  =                      CALL READ(AFT$IN,.PDP$BUFFER,128,
.BYTE$COUNT,
            =                   .READ$STATUS);
 409   8  =                    CALL CONSOL (.(':CI:$'),.(':TO:$')
,.CONSOL$STATU
            -   S);
 410   8  =                    CALL WRITE(0,.PDP$BUFFER,BYTE$COUN
T,.WRITE$STATU
            -   S);
 411   8  =                    CALL CONSOL(.(':CI:$'),.(':VO:$'),
.CONSOL$STATUS
            -   );
 412   8  =                    CALL WRITE(0,.PDP$BUFFER,BYTE$COUN
T,.WRITE$STATU
            -   S);
 413   8  =                    CHAR=' ';
 414   8  =                    IF ((BYTE$COUNT>0) AND (BYTE$COUNT
<128)) THEN
 415   8  =                      DO;
```

```
 416   9  =                          CALL SEND$CHAR$PDP(ACK);
 417   9  =                          SENT$ACK=TRUE;
 418   9  =                        END;
 419   8  =                      COUNT$TEMP=0;
 420   8  =                      DO WHILE (BYTE$COUNT-COUNT$TEMP)<>
0;
 421   9  =                      CALL COUNT$CHAR;
 422   9  =                      COUNT$TEMP=COUNT$TEMP+1;
 423   9  =                      END;
 424   8  =                    END;
 425   7  =                    END;
 426   6  =              END;
 427   5  =              IF(SENT$ACK = FALSE) THEN
 428   5  =                DO;
 429   6  =                  CALL SEND$CHAR$PDP(ACK);
 430   6  =                END;
 431   5  =              CALL CLOSE(AFT$IN,.CLOSE$STATUS);
 432   5  =              CALL PRINT$CHAR$COUNT;
 433   5  =              CALL SEND$STRING$CRT(
       =              .(' BYTES TRANSMITTED FROM FLOPPY DISK TO PDP.
$'));
 434   5  =              CALL CRLF;
 435   5  =              CALL PRINT$TO$CRT(
```

```
          =                .('LEAVING TRANSMIT STATE; ENTER LOOP.$'));
 436   5  =                     RETURN;
 437   5  =                END; /*TRANSMIT */
 438   4  =             END; /* END FOURTH CASE */
 439   3  =          END; /* DO FOREVER */
 440   2          END; /* PDP STRUCTURE */


 441   1          END; /* PDP$MODULE */
```


MODULE INFORMATION:

```
     CODE AREA SIZE     = 09FBH   2555D
     VARIABLE AREA SIZE = 08F3H   2291D
     MAXIMUM STACK SIZE = 000AH     10D
     833 LINES READ
     0 PROGRAM ERROR(S)
```

END OF PL/M-80 COMPILATION

```
ISIS-II PL/M-80 V3.1 COMPILATION OF MODULE PLASMAMODULE
NO OBJECT MODULE REQUESTED
COMPILER INVOKED BY:  PLM80 :F1:PLASMA.MOD NOOBJECT PAGEWIDTH(82) PA
GELENGTH(24) D
                    -ATE(MAY 1979) TITLE('MODULE PLASMA.MOD')



  1           PLASMA$MODULE:DO;
               /* PLASMA MODULE : PRIMITIVES AND EXTERNALS FOR
                   THE TWO PLASMA DEVICES.          */


  2   1       DECLARE LIT LITERALLY 'LITERALLY';
  3   1       DECLARE DCL LIT 'DECLARE';



              $INCLUDE(:F1:PLAEXT.ONE)
          =
```

```
          =      /* PLASMA PRIMITIVES 1 */
          =
          =
          =
          =
   4  1  =   SET$STATUS$PLASMA:PROCEDURE (STATUS) EXTERNAL;
   5  2  =     DCL STATUS BYTE;
   6  2  =   END;
          =
          =
   7  1  =   PLASMA$WRITE:PROCEDURE (CHAR) EXTERNAL;
   8  2  =     DCL CHAR BYTE;
   9  2  =   END;
          =
          =
  10  1  =   CLEAR$PLASMA:PROCEDURE EXTERNAL;
  11  2  =   END;
          =
          =
  12  1  =   PLASMA$WRITE$VECTOR:PROCEDURE (A) EXTERNAL;
  13  2  =     DCL A ADDRESS,
```

```
          =          VECTOR BASED A (4) BYTE,
          =          VPTR BYTE;
  14   2  =    END;
          =
          =
  15   1  =    PLASMA$PRINT$STRING:PROCEDURE (COLUMN,ROW,POINTER) EXT
ERNAL;
  16   2  =      DCL POINTER ADDRESS,
          =          BUFFER BASED POINTER (1) BYTE,
          =          (COLUMN,ROW,COUNT) BYTE;
  17   2  =    END;
          =
          =
  18   1  =     INITIALIZE$PLASMA:PROCEDURE EXTERNAL;
  19   2  =       DCL BUFFER (*) BYTE DATA ('ON LINE.$$');
  20   2  =     END;
          =
          =
  21   1  =     SET$VECTOR:PROCEDURE (X,Y,POINTER) EXTERNAL;
  22   2  =       DCL (X,Y,POINTER) ADDRESS,
          =           VECTOR BASED POINTER (4) BYTE;
  23   2  =    END;
```

```
          =
          =
   24  1  =   START$VECTOR$SOLID:PROCEDURE (X,Y) EXTERNAL;
   25  2  =     DCL (X,Y) ADDRESS,
          =         VECTOR (4) BYTE;
   26  2  =   END;
          =
          =
   27  1  =   STOP$VECTOR$SOLID:PROCEDURE (X,Y) EXTERNAL;
   28  2  =      DCL (X,Y) ADDRESS,
          =          VECTOR (4) BYTE;
   29  2  =   END;
          =
          =
   30  1  =   START$VECTOR$DASH:PROCEDURE (X,Y) EXTERNAL;
   31  2  =      DCL (X,Y) ADDRESS,
          =          VECTOR(4) BYTE;
   32  2  =   END;
          =
          =
   33  1  =   STOP$VECTOR$DASH:PROCEDURE (X,Y) EXTERNAL;
```

```
34   2  =     DCL (X,Y) ADDRESS,
        =          VECTOR (4) BYTE;
35   2  =   END;
        =
        =
        =
36   1  =   GRAPHIC$DESIG:PROCEDURE (X,Y,DESIG) EXTERNAL;
37   2  =     DCL (X,Y,DESIG) ADDRESS,
        =          VALUE BASED DESIG ADDRESS ,
        =          BUFFER (6) BYTE,
        =          (ROW,COLUMN) BYTE;
38   2  =   END;
        =
        =
39   1  =   START$ERASE$VECTOR:PROCEDURE (X,Y) EXTERNAL;
40   2  =     DCL (X,Y) ADDRESS,
        =          VECTOR (4) BYTE;
41   2  =   END;
        =
        =
42   1  =   STOP$ERASE$VECTOR:PROCEDURE(X,Y) EXTERNAL;
```

```
43   2  =       DCL (X,Y) ADDRESS,
        =           VECTOR (4) BYTE;
44   2  =   END;
        =
        =
45   1  =   START$ERASE$DASH:PROCEDURE (X,Y) EXTERNAL;
46   2  =     DCL (X,Y) ADDRESS,
        =         VECTOR (4) BYTE;
47   2  =   END;
        =
        =
48   1  =   STOP$ERASE$DASH:PROCEDURE (X,Y) EXTERNAL;
49   2  =      DCL (X,Y) ADDRESS,
        =         VECTOR (4) BYTE;
50   2  =   END;
        =
        =
        =
        =
        =   /*  END EXTERNAL PLASMA PRIMITIVES 1 */
        =
```

```
                =
                =
                =
                    $INCLUDE(:F1:PLAEXT.TWO)
                =
                =       /* PLASMA PRIMITIVES 2 */
                =
                =
                =
                =
   51    1      =    SET$STATUS$PLASMA$2:PROCEDURE (STATUS) EXTERNAL;
   52    2      =      DCL STATUS BYTE;
   53    2      =    END;
                =
                =
   54    1      =    PLASMA$WRITE$2:PROCEDURE (CHAR) EXTERNAL;
   55    2      =      DCL CHAR BYTE;
   56    2      =    END;
                =
                =
   57    1      =    CLEAR$PLASMA$2:PROCEDURE EXTERNAL;
```

```
  58   2  =    END;
          =
          =
  59   1  =    PLASMA$WRITE$VECTOR$2:PROCEDURE (A) EXTERNAL;
  60   2  =      DCL A ADDRESS,
          =          VECTOR BASED A (4) BYTE,
          =          VPTR BYTE;
  61   2  =    END;
          =
          =
  62   1  =    PLASMA$PRINT$STRING$2:PROCEDURE (COLUMN,ROW,POINTER) E
XTERNAL;
  63   2  =      DCL POINTER ADDRESS,
          =          BUFFER BASED POINTER (1) BYTE,
          =          (COLUMN,ROW,COUNT) BYTE;
  64   2  =    END;
          =
          =
  65   1  =     INITIALIZE$PLASMA$2:PROCEDURE EXTERNAL;
  66   2  =       DCL BUFFER (*) BYTE DATA ('ON LINE.$$');
  67   2  =     END;
          =
```

```
          =
 68   1   =    SET$VECTOR$2:PROCEDURE (X,Y,POINTER) EXTERNAL;
 69   2   =      DCL (X,Y,POINTER) ADDRESS,
          =          VECTOR BASED POINTER (4) BYTE;
 70   2   =   END;
          =
          =
 71   1   =   START$VECTOR$SOLID$2:PROCEDURE (X,Y) EXTERNAL;
 72   2   =     DCL (X,Y) ADDRESS,
          =         VECTOR (4) BYTE;
 73   2   =   END;
          =
          =
 74   1   =   STOP$VECTOR$SOLID$2:PROCEDURE (X,Y) EXTERNAL;
 75   2   =      DCL (X,Y) ADDRESS,
          =          VECTOR (4) BYTE;
 76   2   =   END;
          =
          =
 77   1   =   START$VECTOR$DASH$2:PROCEDURE (X,Y) EXTERNAL;
 78   2   =      DCL (X,Y) ADDRESS,
```

```
          =          VECTOR(4) BYTE;
 79   2   =   END;
          =
          =
 80   1   =   STOP$VECTOR$DASH$2:PROCEDURE (X,Y) EXTERNAL;
 81   2   =     DCL (X,Y) ADDRESS,
          =         VECTOR (4) BYTE;
 82   2   =   END;
          =
          =
          =
 83   1   =   GRAPHIC$DESIG$2:PROCEDURE (X,Y,DESIG) EXTERNAL;
 84   2   =     DCL (X,Y,DESIG) ADDRESS,
          =         VALUE BASED DESIG ADDRESS ,
          =         BUFFER (6) BYTE,
          =         (ROW,COLUMN) BYTE;
 85   2   =   END;
          =
          =
 86   1   =   START$ERASE$VECTOR$2:PROCEDURE (X,Y) EXTERNAL;
 87   2   =     DCL (X,Y) ADDRESS,
```

```
          =          VECTOR (4) BYTE;
 88   2   =    END;
          =
          =
 89   1   =    STOP$ERASE$VECTOR$2:PROCEDURE(X,Y) EXTERNAL;
 90   2   =       DCL (X,Y) ADDRESS,
          =           VECTOR (4) BYTE;
 91   2   =    END;
          =
          =
 92   1   =    START$ERASE$DASH$2:PROCEDURE (X,Y) EXTERNAL;
 93   2   =      DCL (X,Y) ADDRESS,
          =          VECTOR (4) BYTE;
 94   2   =    END;
          =
          =
 95   1   =    STOP$ERASE$DASH$2:PROCEDURE (X,Y) EXTERNAL;
 96   2   =       DCL (X,Y) ADDRESS,
          =          VECTOR (4) BYTE;
 97   2   =    END;
          =
```

```
                =
                =
                =
                =    /*  END EXTERNAL PLASMA PRIMITIVES 2 */
                =
                     $INCLUDE(:F1:PLAPUB.ONE)
                =     /* DECLARE PLASMA PUBLIC PROCEDURES FOR PLASMA DEVICE
 ONE */
                =
                =
                =
  98    1       =    WRITE$CONTACT$ID: PROCEDURE (X,Y,J) PUBLIC ;
                =
                =     /* THIS PROCEDURE WRITES CONTACT ID ADJACENT TO SYMBO
L. */
  99    2       =    DCL (ROW,COLUMN,J) BYTE ;
 100    2       =    DCL (X,Y) ADDRESS ;
 101    2       =    DCL CONTACT$ID (3) BYTE ;
 102    2       =    CONTACT$ID(0)=J+'0';
 103    2       =    CONTACT$ID(1)='$';
 104    2       =    CONTACT$ID(2)='$';
 105    2       =    ROW=Y/16;
 106    2       =    COLUMN=((X-14)/6);
```

```
107   2  =    IF (X<=8) THEN COLUMN=0 ;
109   2  =    IF (X>=9) AND (X<=44) THEN COLUMN=X/6 ;
111   2  =    IF (X>=494) THEN COLUMN=75;
113   2  =    CALL PLASMA$PRINT$STRING(COLUMN,ROW,.CONTACT$ID);
114   2  =    END;  /* WRITE$CONTACT$ID */
             =
             =
             =
             =
             =
             =
             =
115   1  =    DRAW$GRID: PROCEDURE PUBLIC;
             =
             =    /* THIS PROCEDURE DRAWS A GRID IN PLASMA DEVICE ONE */
116   2  =    DCL (W,I,J) BYTE ;
117   2  =      DCL (X,Y) ADDRESS;
118   2  =      CALL CLEAR$PLASMA;
119   2  =      X=127;
120   2  =      Y=0;
121   2  =      CALL START$VECTOR$SOLID(X,Y);
```

```
122   2  =      X=127;
123   2  =      Y=511;
124   2  =      CALL STOP$VECTOR$SOLID(X,Y);
125   2  =      X=255;
126   2  =      Y=0;
127   2  =      CALL START$VECTOR$SOLID(X,Y);
128   2  =      X=255;
129   2  =      Y=511;
130   2  =      CALL STOP$VECTOR$SOLID(X,Y);
131   2  =      X=383;
132   2  =      Y=0;
133   2  =      CALL START$VECTOR$SOLID(X,Y);
134   2  =      X=383;
135   2  =      Y=511;
136   2  =      CALL STOP$VECTOR$SOLID(X,Y);
137   2  =      X=0;
138   2  =      Y=127;
139   2  =      CALL START$VECTOR$SOLID(X,Y);
140   2  =      X=511;
141   2  =      Y=127;
142   2  =      CALL STOP$VECTOR$SOLID(X,Y);
```

```
143   2  =      X=0;
144   2  =      Y=255;
145   2  =      CALL START$VECTOR$SOLID(X,Y);
146   2  =      X=511;
147   2  =      Y=255;
148   2  =      CALL STOP$VECTOR$SOLID(X,Y);
149   2  =      X=0;
150   2  =      Y=383;
151   2  =      CALL START$VECTOR$SOLID(X,Y);
152   2  =      X=511;
153   2  =      Y=383;
154   2  =      CALL STOP$VECTOR$SOLID(X,Y);
            =
            =    /* LABEL GRID */
155   2  =    W=1;
156   2  =    Y=118;
157   2  =    DO I=1 TO 2;
158   3  =      X=4;
159   3  =      DO J = 1 TO 4 ;
160   4  =       CALL WRITE$CONTACT$ID(X,Y,W);
161   4  =       X=X+128;
```

```
162   4  =       W=W+1;
163   4  =     END; /* DO J */
164   3  =     Y=246;
165   3  =   END; /* DO I */
166   2  =   CALL WRITE$CONTACT$ID(4,374,9);
167   2  =   CALL WRITE$CONTACT$ID(4,502,1);
168   2  =   CALL WRITE$CONTACT$ID(10,502,3);
169   2  =   W=0;
170   2  =   Y=374;
171   2  =   DO I = 1 TO 2 ;
172   3  =     X=131;
173   3  =      DO J=1 TO 3 ;
174   4  =        CALL WRITE$CONTACT$ID(X,Y,1);
175   4  =        CALL WRITE$CONTACT$ID(X+6,Y,W);
176   4  =        X=X+128;
177   4  =        W=W+1;
178   4  =      END; /* DO J */
179   3  =      W=W+1;
180   3  =      Y=502;
181   3  =   END; /* DO I */
          =
```

```
 182   2  =    END; /* DRAW$GRID */
            =
            =
            =
 183   1  =    DRAW$FRIEND$SYMBOL: PROCEDURE (X,Y,S) PUBLIC;
            =
            =    /* THIS PROCEDURE DRAWS A SOLID CIRCLE WHICH REPRESENT
S
            =         A FRIENDLY SHIP */
 184   2  =      DCL (X,Y,TX,TY) ADDRESS;
 185   2  =      DCL S BYTE;
 186   2  =      IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
            =      THEN
 187   2  =      RETURN; /* CANNOT DRAW SYMBOL, NEAR EDGE OF SCREEN.
*/
 188   2  =      TX = S*(X-2);
 189   2  =      TY = S*(Y-6);
 190   2  =      CALL START$VECTOR$SOLID(TX,TY);
 191   2  =      TX = S*(X+2);
 192   2  =      TY = S*(Y-6);
 193   2  =      CALL STOP$VECTOR$SOLID(TX,TY);
 194   2  =      TX = S*(X+6);
 195   2  =      TY = S*(Y-2);
```

```
196   2  =     CALL STOP$VECTOR$SOLID(TX,TY);
197   2  =     TX = S*(X+6);
198   2  =     TY = S*(Y+2);
199   2  =     CALL STOP$VECTOR$SOLID(TX,TY);
200   2  =     TX = S*(X+2);
201   2  =     TY = S*(Y+6);
202   2  =     CALL STOP$VECTOR$SOLID(TX,TY);
203   2  =     TX = S*(X-2);
204   2  =     TY = S*(Y+6);
205   2  =     CALL STOP$VECTOR$SOLID(TX,TY);
206   2  =     TX = S*(X-6);
207   2  =     TY = S*(Y+2);
208   2  =     CALL STOP$VECTOR$SOLID(TX,TY);
209   2  =     TX = S*(X-6);
210   2  =     TY = S*(Y-2);
211   2  =     CALL STOP$VECTOR$SOLID(TX,TY);
212   2  =     TX = S*(X-2);
213   2  =     TY = S*(Y-6);
214   2  =     CALL STOP$VECTOR$SOLID(TX,TY);
215   2  =   END; /* DRAW$FRIEND$SYMBOL */
         =
```

```
            =
            =
 216    1   =    DRAW$FRIEND$DASH: PROCEDURE (X,Y,S) PUBLIC;
            =
            =    /* THIS PROCEDURE DRAWS A DASHED CIRCLE WHICH REPRESEN
TS
            =        A FRIENDLY SHIP */
 217    2   =      DCL (X,Y,TX,TY) ADDRESS;
 218    2   =      DCL S BYTE;
 219    2   =      IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
            =      THEN
 220    2   =      RETURN; /* CANNOT DRAW SYMBOL, NEAR EDGE OF SCREEN.
*/
 221    2   =      TX = S*(X+6);
 222    2   =      TY = S*(Y+2);
 223    2   =      CALL START$VECTOR$DASH(TX,TY);
 224    2   =      TX = S*(X+2);
 225    2   =      TY = S*(Y+6);
 226    2   =      CALL STOP$VECTOR$DASH(TX,TY);
 227    2   =      TX = S*(X-2);
 228    2   =      TY = S*(Y+6);
 229    2   =      CALL START$VECTOR$DASH(TX,TY);
 230    2   =      TX = S*(X-6);
```

```
231   2  =      TY = S*(Y+2);
232   2  =      CALL STOP$VECTOR$DASH(TX,TY);
233   2  =    END; /* DRAW$FRIEND$DASH */
           =
           =
           =
234   1  =    ERASE$FRIEND$DASH: PROCEDURE (X,Y,S) PUBLIC;
           =
           =    /* THIS PROCEDURE ERASES A DASHED CIRCLE WHICH REPRESE
NTS
           =        A FRIENDLY SHIP */
235   2  =      DCL (X,Y,TX,TY) ADDRESS;
236   2  =      DCL S BYTE;
237   2  =      IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
           =      THEN
238   2  =      RETURN; /* CANNOT ERASE SYMBOL, NEAR EDGE OF SCREEN.
*/
239   2  =      TX = S*(X+6);
240   2  =      TY = S*(Y+2);
241   2  =      CALL START$ERASE$DASH(TX,TY);
242   2  =      TX = S*(X+2);
243   2  =      TY = S*(Y+6);
244   2  =      CALL STOP$ERASE$DASH(TX,TY);
```

```
 245   2  =     TX = S*(X-2);
 246   2  =     TY = S*(Y+6);
 247   2  =     CALL START$ERASE$DASH(TX,TY);
 248   2  =     TX = S*(X-6);
 249   2  =     TY = S*(Y+2);
 250   2  =     CALL STOP$ERASE$DASH(TX,TY);
 251   2  =   END; /* ERASE$FRIEND$DASH */
           =
           =
           =
 252   1  =   ERASE$FRIEND$SYMBOL: PROCEDURE (X,Y,S) PUBLIC;
           =
           =   /* THIS PROCEDURE ERASES A SOLID CIRCLE WHICH REPRESEN
TS
           =       A FRIENDLY SHIP */
 253   2  =     DCL (X,Y,TX,TY) ADDRESS;
 254   2  =     DCL S BYTE;
 255   2  =     IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
           =     THEN
 256   2  =     RETURN; /* CANNOT ERASE SYMBOL, NEAR EDGE OF SCREEN.
*/
 257   2  =     TX = S*(X-2);
 258   2  =     TY = S*(Y-6);
```

```
259   2  =     CALL START$ERASE$VECTOR(TX,TY);
260   2  =     TX = S*(X+2);
261   2  =     TY = S*(Y-6);
262   2  =     CALL STOP$ERASE$VECTOR(TX,TY);
263   2  =     TX = S*(X+6);
264   2  =     TY = S*(Y-2);
265   2  =     CALL STOP$ERASE$VECTOR(TX,TY);
266   2  =     TX = S*(X+6);
267   2  =     TY = S*(Y+2);
268   2  =     CALL STOP$ERASE$VECTOR(TX,TY);
269   2  =     TX = S*(X+2);
270   2  =     TY = S*(Y+6);
271   2  =     CALL STOP$ERASE$VECTOR(TX,TY);
272   2  =     TX = S*(X-2);
273   2  =     TY = S*(Y+6);
274   2  =     CALL STOP$ERASE$VECTOR(TX,TY);
275   2  =     TX = S*(X-6);
276   2  =     TY = S*(Y+2);
277   2  =     CALL STOP$ERASE$VECTOR(TX,TY);
278   2  =     TX = S*(X-6);
279   2  =     TY = S*(Y-2);
```

```
280   2  =      CALL STOP$ERASE$VECTOR(TX,TY);
281   2  =      TX = S*(X-2);
282   2  =      TY = S*(Y-6);
283   2  =      CALL STOP$ERASE$VECTOR(TX,TY);
284   2  =    END; /* ERASE$FRIEND$SYMBOL */
             =
             =
             =
             =
             =
285   1  =    DRAW$HOSTILE$SYMBOL:PROCEDURE(X,Y,S) PUBLIC;
             =
             =    /* THIS PROCEDURE DRAWS A SOLID DIAMOND WHICH
             =       REPRESENTS A HOSTILE SHIP.  */
             =
286   2  =    DCL (X,Y,TX,TY) ADDRESS;
287   2  =    DCL S BYTE;
288   2  =    IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
             =     THEN RETURN;   /* CAN NOT DRAW SYMBOL */
290   2  =    TX=S*(X);
291   2  =    TY=S*(Y-6);
```

```
292   2  =    CALL START$VECTOR$SOLID(TX,TY);
293   2  =    TX=S*(X+6);
294   2  =    TY=S*(Y);
295   2  =    CALL STOP$VECTOR$SOLID(TX,TY);
296   2  =    TX=S*(X);
297   2  =    TY=S*(Y+6);
298   2  =    CALL STOP$VECTOR$SOLID(TX,TY);
299   2  =    TX=S*(X-6);
300   2  =    TY=S*(Y);
301   2  =    CALL STOP$VECTOR$SOLID(TX,TY);
302   2  =    TX=S*(X);
303   2  =    TY=S*(Y-6);
304   2  =    CALL STOP$VECTOR$SOLID(TX,TY);
305   2  =    END; /*DRAW$HOSTILE$SYMBOL */
             =
             =
             =
             =
306   1  =    DRAW$HOSTILE$DASH:PROCEDURE(X,Y,S) PUBLIC;
             =
             =    /* THIS PROCEDURE DRAWS A DASHED DIAMOND WHICH
```

```
          =       REPRESENTS A HOSTILE SHIP.  */
          =
307    2  =    DCL (X,Y,TX,TY) ADDRESS;
308    2  =    DCL S BYTE;
309    2  =    IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
          =     THEN RETURN;    /* CAN NOT DRAW SYMBOL */
311    2  =    TX=S*(X);
312    2  =    TY=S*(Y+6);
313    2  =    CALL START$VECTOR$DASH(TX,TY);
314    2  =    TX=S*(X-6);
315    2  =    TY=S*(Y);
316    2  =    CALL STOP$VECTOR$DASH(TX,TY);
317    2  =    END; /*DRAW$HOSTILE$DASH */
          =
          =
          =
          =
318    1  =    ERASE$HOSTILE$SYMBOL:PROCEDURE(X,Y,S) PUBLIC;
          =
          =    /* THIS PROCEDURE ERASES A SOLID DIAMOND WHICH
          =       REPRESENTS A HOSTILE SHIP.  */
```

```
          =
319   2   =    DCL (X,Y,TX,TY) ADDRESS;
320   2   =    DCL S BYTE;
321   2   =    IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
          =     THEN RETURN;   /* CAN NOT ERASE SYMBOL */
323   2   =    TX=S*(X);
324   2   =    TY=S*(Y-6);
325   2   =    CALL START$ERASE$VECTOR(TX,TY);
326   2   =    TX=S*(X+6);
327   2   =    TY=S*(Y);
328   2   =    CALL STOP$ERASE$VECTOR(TX,TY);
329   2   =    TX=S*(X);
330   2   =    TY=S*(Y+6);
331   2   =    CALL STOP$ERASE$VECTOR(TX,TY);
332   2   =    TX=S*(X-6);
333   2   =    TY=S*(Y);
334   2   =    CALL STOP$ERASE$VECTOR(TX,TY);
335   2   =    TX=S*(X);
336   2   =    TY=S*(Y-6);
337   2   =    CALL STOP$ERASE$VECTOR(TX,TY);
338   2   =    END; /*ERASE$HOSTILE$SYMBOL */
```

```
                =
                =
                =
                =
339    1        =    ERASE$HOSTILE$DASH:PROCEDURE(X,Y,S) PUBLIC;
                =
                =    /* THIS PROCEDURE ERASES A DASHED DIAMOND WHICH
                =       REPRESENTS A HOSTILE SHIP.  */
                =
340    2        =    DCL (X,Y,TX,TY) ADDRESS;
341    2        =    DCL S BYTE;
342    2        =    IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
                =     THEN RETURN;   /* CAN NOT ERASE SYMBOL */
344    2        =    TX=S*(X);
345    2        =    TY=S*(Y+6);
346    2        =    CALL START$ERASE$DASH(TX,TY);
347    2        =    TX=S*(X-6);
348    2        =    TY=S*(Y);
349    2        =    CALL STOP$ERASE$DASH(TX,TY);
350    2        =    END; /*ERASE$HOSTILE$DASH */
                =
```

```
            =
            =
            =   /* END PLASMA PUBLICS FOR PLASMA DEVICE ONE. */
                $INCLUDE(:F1:UNKNOW.SR1)
            =
351    1    =   DRAW$UNKNOWN$SYMBOL:PROCEDURE (X,Y,S) PUBLIC;
            =
            =   /* THIS PROCEDURE DRAWS A SOLID SQUARE WHICH
            =      REPRESENTS AN UNKNOWN SHIP.       */
352    2    =   DCL (X,Y,TX,TY) ADDRESS;
353    2    =   DCL S BYTE;
354    2    =   IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
            =   THEN RETURN;  /* CAN NOT DRAW SYMBOL */
356    2    =   TX=S*(X-5);
357    2    =   TY=S*(Y-5);
358    2    =   CALL START$VECTOR$SOLID(TX,TY);
359    2    =   TX=S*(X+5);
360    2    =   TY=S*(Y-5);
361    2    =   CALL STOP$VECTOR$SOLID(TX,TY);
362    2    =   TX=S*(X+5);
363    2    =   TY=S*(Y+5);
```

```
364   2  =    CALL STOP$VECTOR$SOLID(TX,TY);
365   2  =    TX=S*(X-5);
366   2  =    TY=S*(Y+5);
367   2  =    CALL STOP$VECTOR$SOLID(TX,TY);
368   2  =    TX=S*(X-5);
369   2  =    TY =S*(Y-5);
370   2  =    CALL STOP$VECTOR$SOLID(TX,TY);
371   2  =    END; /* DRAW$UNKNOWN$SYMBOL */
             =
             =
372   1  =    ERASE$UNKNOWN$SYMBOL:PROCEDURE (X,Y,S) PUBLIC;
             =
             =    /* THIS PROCEDURE ERASES A SOLID SQUARE WHICH
             =       REPRESENTS AN UNKNOWN SHIP.       */
373   2  =    DCL (X,Y,TX,TY) ADDRESS;
374   2  =    DCL S BYTE;
375   2  =    IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
             =    THEN RETURN;  /* CAN NOT ERASE SYMBOL */
377   2  =    TX=S*(X-5);
378   2  =    TY=S*(Y-5);
379   2  =    CALL START$ERASE$VECTOR(TX,TY);
```

```
380   2  =    TX=S*(X+5);
381   2  =    TY=S*(Y-5);
382   2  =    CALL STOP$ERASE$VECTOR(TX,TY);
383   2  =    TX=S*(X+5);
384   2  =    TY=S*(Y+5);
385   2  =    CALL STOP$ERASE$VECTOR(TX,TY);
386   2  =    TX=S*(X-5);
387   2  =    TY=S*(Y+5);
388   2  =    CALL STOP$ERASE$VECTOR(TX,TY);
389   2  =    TX=S*(X-5);
390   2  =    TY =S*(Y-5);
391   2  =    CALL STOP$ERASE$VECTOR(TX,TY);
392   2  =    END; /* ERASE$UNKNOWN$SYMBOL */
             =
             =
393   1  =    DRAW$UNKNOWN$DASH:PROCEDURE (X,Y,S) PUBLIC;
             =
             =    /* THIS PROCEDURE DRAWS A DASH SQUARE WHICH
             =       REPRESENTS AN UNKNOWN SHIP.       */
394   2  =    DCL (X,Y,TX,TY) ADDRESS;
395   2  =    DCL S BYTE;
```

```
396   2  =    IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
           =    THEN RETURN;  /* CAN NOT DRAW SYMBOL */
398   2  =    TX=S*(X+5);
399   2  =    TY=S*(Y+5);
400   2  =    CALL START$VECTOR$DASH(TX,TY);
401   2  =    TX=S*(X-5);
402   2  =    TY=S*(Y+5);
403   2  =    CALL STOP$VECTOR$DASH(TX,TY);
404   2  =    END; /* DRAW$UNKNOWN$DASH */
           =
           =
405   1  =    ERASE$UNKNOWN$DASH:PROCEDURE (X,Y,S) PUBLIC;
           =
           =    /* THIS PROCEDURE ERASES A DASHED SQUARE WHICH
           =       REPRESENTS AN UNKNOWN SHIP.       */
406   2  =    DCL (X,Y,TX,TY) ADDRESS;
407   2  =    DCL S BYTE;
408   2  =    IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
           =    THEN RETURN;  /* CAN NOT ERASE SYMBOL */
410   2  =    TX=S*(X+5);
411   2  =    TY=S*(Y+5);
```

425

```
 412   2  =    CALL START$ERASE$DASH(TX,TY);
 413   2  =    TX=S*(X-5);
 414   2  =    TY=S*(Y+5);
 415   2  =    CALL STOP$ERASE$DASH(TX,TY);
 416   2  =    END; /* ERASE$UNKNOWN$DASH */
              $INCLUDE(:F1:PLAPUB.TWO)
          =
          =
          =    /* DECLARE PLASMA PUBLIC PROCEDURES FOR PLASMA DEVICE
TWO. */
          =
 417   1  =    WRITE$CONTACT$ID$2: PROCEDURE (X,Y,J) PUBLIC ;
          =
          =     /* THIS PROCEDURE WRITES CONTACTS ID ADJACENT TO SYMB
OLS. */
 418   2  =    DCL (ROW,COLUMN,J) BYTE ;
 419   2  =    DCL (X,Y) ADDRESS ;
 420   2  =    DCL CONTACT$ID (3) BYTE ;
 421   2  =    CONTACT$ID(0)=J+'0';
 422   2  =    CONTACT$ID(1)='$';
 423   2  =    CONTACT$ID(2)='$';
 424   2  =    ROW=Y/16;
 425   2  =    COLUMN=((X-14)/6);
```

```
426   2  =    IF (X<=8) THEN COLUMN=0;
428   2  =    IF (X>=9) AND (X<=44) THEN COLUMN=X/6;
430   2  =    IF (X>=494) THEN COLUMN=75;
432   2  =    CALL PLASMA$PRINT$STRING$2(COLUMN,ROW,.CONTACT$ID);
433   2  =    END; /* WRITE$CONTACT$ID$2 */
             =
             =
             =
             =
             =
             =
434   1  =    DRAW$GRID$2: PROCEDURE PUBLIC;
             =
             =    /* THIS PROCEDURE DRAWS A GRID IN PLASMA DEVICE ONE */
435   2  =    DCL (W,I,J) BYTE ;
436   2  =      DCL (X,Y) ADDRESS;
437   2  =      CALL CLEAR$PLASMA$2;
438   2  =      X=127;
439   2  =      Y=0;
440   2  =      CALL START$VECTOR$SOLID$2(X,Y);
441   2  =      X=127;
```

```
442   2  =      Y=511;
443   2  =      CALL STOP$VECTOR$SOLID$2(X,Y);
444   2  =      X=255;
445   2  =      Y=0;
446   2  =      CALL START$VECTOR$SOLID$2(X,Y);
447   2  =      X=255;
448   2  =      Y=511;
449   2  =      CALL STOP$VECTOR$SOLID$2(X,Y);
450   2  =      X=383;
451   2  =      Y=0;
452   2  =      CALL START$VECTOR$SOLID$2(X,Y);
453   2  =      X=383;
454   2  =      Y=511;
455   2  =      CALL STOP$VECTOR$SOLID$2(X,Y);
456   2  =      X=0;
457   2  =      Y=127;
458   2  =      CALL START$VECTOR$SOLID$2(X,Y);
459   2  =      X=511;
460   2  =      Y=127;
461   2  =      CALL STOP$VECTOR$SOLID$2(X,Y);
462   2  =      X=0;
```

```
463   2  =      Y=255;
464   2  =      CALL START$VECTOR$SOLID$2(X,Y);
465   2  =      X=511;
466   2  =      Y=255;
467   2  =      CALL STOP$VECTOR$SOLID$2(X,Y);
468   2  =      X=0;
469   2  =      Y=383;
470   2  =      CALL START$VECTOR$SOLID$2(X,Y);
471   2  =      X=511;
472   2  =      Y=383;
473   2  =      CALL STOP$VECTOR$SOLID$2(X,Y);
          =
          =    /* LABEL GRID */
474   2  =    W=1;
475   2  =    Y=118;
476   2  =    DO I = 1 TO 2;
477   3  =      X=4;
478   3  =      DO J = 1 TO 4 ;
479   4  =        CALL WRITE$CONTACT$ID$2(X,Y,W);
480   4  =        X=X+128;
481   4  =        W=W+1;
```

```
482   4  =       END; /* DO J */
483   3  =       Y=246;
484   3  =     END; /* DO I */
485   2  =     CALL WRITE$CONTACT$ID$2(4,374,9);
486   2  =     CALL WRITE$CONTACT$ID$2(4,502,1);
487   2  =     CALL WRITE$CONTACT$ID$2(10,502,3);
488   2  =     W=0;
489   2  =     Y=374;
490   2  =     DO I = 1 TO 2 ;
491   3  =       X=131;
492   3  =       DO J = 1 TO 3 ;
493   4  =         CALL WRITE$CONTACT$ID$2(X,Y,1);
494   4  =         CALL WRITE$CONTACT$ID$2(X+6,Y,W);
495   4  =         X=X+128;
496   4  =         W=W+1;
497   4  =       END; /* DO J */
498   3  =       W=W+1;
499   3  =       Y=502;
500   3  =     END;  /* DO I */
          =
501   2  =     END; /* DRAW$GRID$2 */
```

```
                =
                =
                =
 502    1       =    DRAW$FRIEND$SYMBOL$2: PROCEDURE (X,Y,S) PUBLIC;
                =
                =    /* THIS PROCEDURE DRAWS A SOLID CIRCLE WHICH REPRESENT
S
                =       A FRIENDLY SHIP */
 503    2       =      DCL (X,Y,TX,TY) ADDRESS;
 504    2       =      DCL S BYTE;
 505    2       =      IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
                =      THEN
 506    2       =      RETURN; /* CANNOT DRAW SYMBOL, NEAR EDGE OF SCREEN.
*/
 507    2       =      TX = S*(X-2);
 508    2       =      TY = S*(Y-6);
 509    2       =      CALL START$VECTOR$SOLID$2(TX,TY);
 510    2       =      TX = S*(X+2);
 511    2       =      TY = S*(Y-6);
 512    2       =      CALL STOP$VECTOR$SOLID$2(TX,TY);
 513    2       =      TX = S*(X+6);
 514    2       =      TY = S*(Y-2);
 515    2       =      CALL STOP$VECTOR$SOLID$2(TX,TY);
```

```
516   2  =     TX = S*(X+6);
517   2  =     TY = S*(Y+2);
518   2  =     CALL STOP$VECTOR$SOLID$2(TX,TY);
519   2  =     TX = S*(X+2);
520   2  =     TY = S*(Y+6);
521   2  =     CALL STOP$VECTOR$SOLID$2(TX,TY);
522   2  =     TX = S*(X-2);
523   2  =     TY = S*(Y+6);
524   2  =     CALL STOP$VECTOR$SOLID$2(TX,TY);
525   2  =     TX = S*(X-6);
526   2  =     TY = S*(Y+2);
527   2  =     CALL STOP$VECTOR$SOLID$2(TX,TY);
528   2  =     TX = S*(X-6);
529   2  =     TY = S*(Y-2);
530   2  =     CALL STOP$VECTOR$SOLID$2(TX,TY);
531   2  =     TX = S*(X-2);
532   2  =     TY = S*(Y-6);
533   2  =     CALL STOP$VECTOR$SOLID$2(TX,TY);
534   2  =   END; /* DRAW$FRIEND$SYMBOL$2 */
           =
           =
```

```
                =
 535    1       =    DRAW$FRIEND$DASH$2: PROCEDURE (X,Y,S) PUBLIC;
                =
                =    /* THIS PROCEDURE DRAWS A DASHED CIRCLE WHICH REPRESEN
TS
                =       A FRIENDLY SHIP */
 536    2       =      DCL (X,Y,TX,TY) ADDRESS;
 537    2       =      DCL S BYTE;
 538    2       =      IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
                =      THEN
 539    2       =      RETURN; /* CANNOT DRAW SYMBOL, NEAR EDGE OF SCREEN.
*/
 540    2       =      TX = S*(X+6);
 541    2       =      TY = S*(Y+2);
 542    2       =      CALL START$VECTOR$DASH$2(TX,TY);
 543    2       =      TX = S*(X+2);
 544    2       =      TY = S*(Y+6);
 545    2       =      CALL STOP$VECTOR$DASH$2(TX,TY);
 546    2       =      TX = S*(X-2);
 547    2       =      TY = S*(Y+6);
 548    2       =      CALL START$VECTOR$DASH$2(TX,TY);
 549    2       =      TX = S*(X-6);
 550    2       =      TY = S*(Y+2);
```

```
 551   2  =     CALL STOP$VECTOR$DASH$2(TX,TY);
 552   2  =   END; /* DRAW$FRIEND$DASH$2 */
            =
            =
            =
 553   1  =   ERASE$FRIEND$DASH$2: PROCEDURE (X,Y,S) PUBLIC;
            =
            =   /* THIS PROCEDURE ERASES A DASHED CIRCLE WHICH REPRESE
NTS
            =       A FRIENDLY SHIP */
 554   2  =     DCL (X,Y,TX,TY) ADDRESS;
 555   2  =     DCL S BYTE;
 556   2  =     IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
            =     THEN
 557   2  =     RETURN; /* CANNOT ERASE SYMBOL, NEAR EDGE OF SCREEN.
*/
 558   2  =     TX = S*(X+6);
 559   2  =     TY = S*(Y+2);
 560   2  =     CALL START$ERASE$DASH$2(TX,TY);
 561   2  =     TX = S*(X+2);
 562   2  =     TY = S*(Y+6);
 563   2  =     CALL STOP$ERASE$DASH$2(TX,TY);
 564   2  =     TX = S*(X-2);
```

```
 565   2  =     TY = S*(Y+6);
 566   2  =     CALL START$ERASE$DASH$2(TX,TY);
 567   2  =     TX = S*(X-6);
 568   2  =     TY = S*(Y+2);
 569   2  =     CALL STOP$ERASE$DASH$2(TX,TY);
 570   2  =   END; /* ERASE$FRIEND$DASH$2 */
            =
            =
            =
 571   1  =   ERASE$FRIEND$SYMBOL$2: PROCEDURE (X,Y,S) PUBLIC;
            =
            =   /* THIS PROCEDURE ERASES A SOLID CIRCLE WHICH REPRESEN
TS
            =       A FRIENDLY SHIP */
 572   2  =     DCL (X,Y,TX,TY) ADDRESS;
 573   2  =     DCL S BYTE;
 574   2  =     IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
            =     THEN
 575   2  =     RETURN; /* CANNOT ERASE SYMBOL, NEAR EDGE OF SCREEN.
 */
 576   2  =     TX = S*(X-2);
 577   2  =     TY = S*(Y-6);
 578   2  =     CALL START$ERASE$VECTOR$2(TX,TY);
```

```
579   2  =      TX = S*(X+2);
580   2  =      TY = S*(Y-6);
581   2  =      CALL STOP$ERASE$VECTOR$2(TX,TY);
582   2  =      TX = S*(X+6);
583   2  =      TY = S*(Y-2);
584   2  =      CALL STOP$ERASE$VECTOR$2(TX,TY);
585   2  =      TX = S*(X+6);
586   2  =      TY = S*(Y+2);
587   2  =      CALL STOP$ERASE$VECTOR$2(TX,TY);
588   2  =      TX = S*(X+2);
589   2  =      TY = S*(Y+6);
590   2  =      CALL STOP$ERASE$VECTOR$2(TX,TY);
591   2  =      TX = S*(X-2);
592   2  =      TY = S*(Y+6);
593   2  =      CALL STOP$ERASE$VECTOR$2(TX,TY);
594   2  =      TX = S*(X-6);
595   2  =      TY = S*(Y+2);
596   2  =      CALL STOP$ERASE$VECTOR$2(TX,TY);
597   2  =      TX = S*(X-6);
598   2  =      TY = S*(Y-2);
599   2  =      CALL STOP$ERASE$VECTOR$2(TX,TY);
```

```
600   2  =     TX = S*(X-2);
601   2  =     TY = S*(Y-6);
602   2  =     CALL STOP$ERASE$VECTOR$2(TX,TY);
603   2  =   END; /* ERASE$FRIEND$SYMBOL$2 */
           =
           =
           =
           =
           =
604   1  =   DRAW$HOSTILE$SYMBOL$2:PROCEDURE(X,Y,S) PUBLIC;
           =
           =   /* THIS PROCEDURE DRAWS A SOLID DIAMOND WHICH
           =      REPRESENTS A HOSTILE SHIP.  */
           =
605   2  =   DCL (X,Y,TX,TY) ADDRESS;
606   2  =   DCL S BYTE;
607   2  =   IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
           =    THEN RETURN;   /* CAN NOT DRAW SYMBOL */
609   2  =   TX=S*(X);
610   2  =   TY=S*(Y-6);
611   2  =   CALL START$VECTOR$SOLID$2(TX,TY);
```

```
612   2  =    TX=S*(X+6);
613   2  =    TY=S*(Y);
614   2  =    CALL STOP$VECTOR$SOLID$2(TX,TY);
615   2  =    TX=S*(X);
616   2  =    TY=S*(Y+6);
617   2  =    CALL STOP$VECTOR$SOLID$2(TX,TY);
618   2  =    TX=S*(X-6);
619   2  =    TY=S*(Y);
620   2  =    CALL STOP$VECTOR$SOLID$2(TX,TY);
621   2  =    TX=S*(X);
622   2  =    TY=S*(Y-6);
623   2  =    CALL STOP$VECTOR$SOLID$2(TX,TY);
624   2  =    END; /*DRAW$HOSTILE$SYMBOL$2 */
             =
             =
             =
             =
625   1  =    DRAW$HOSTILE$DASH$2:PROCEDURE(X,Y,S) PUBLIC;
             =
             =    /* THIS PROCEDURE DRAWS A DASHED DIAMOND WHICH
             =       REPRESENTS A HOSTILE SHIP.  */
```

```
      =
626   2  =   DCL (X,Y,TX,TY) ADDRESS;
627   2  =   DCL S BYTE;
628   2  =   IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
      =       THEN RETURN;   /* CAN NOT DRAW SYMBOL */
630   2  =   TX=S*(X);
631   2  =   TY=S*(Y+6);
632   2  =   CALL START$VECTOR$DASH$2(TX,TY);
633   2  =   TX=S*(X-6);
634   2  =   TY=S*(Y);
635   2  =   CALL STOP$VECTOR$DASH$2(TX,TY);
636   2  =   END; /*DRAW$HOSTILE$DASH$2 */
      =
      =
      =
      =
637   1  =   ERASE$HOSTILE$SYMBOL$2:PROCEDURE(X,Y,S) PUBLIC;
      =
      =   /* THIS PROCEDURE ERASES A SOLID DIAMOND WHICH
      =      REPRESENTS A HOSTILE SHIP.  */
      =
```

```
638   2  =   DCL (X,Y,TX,TY) ADDRESS;
639   2  =   DCL S BYTE;
640   2  =   IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
         =    THEN RETURN;   /* CAN NOT ERASE SYMBOL */
642   2  =   TX=S*(X);
643   2  =   TY=S*(Y-6);
644   2  =   CALL START$ERASE$VECTOR$2(TX,TY);
645   2  =   TX=S*(X+6);
646   2  =   TY=S*(Y);
647   2  =   CALL STOP$ERASE$VECTOR$2(TX,TY);
648   2  =   TX=S*(X);
649   2  =   TY=S*(Y+6);
650   2  =   CALL STOP$ERASE$VECTOR$2(TX,TY);
651   2  =   TX=S*(X-6);
652   2  =   TY=S*(Y);
653   2  =   CALL STOP$ERASE$VECTOR$2(TX,TY);
654   2  =   TX=S*(X);
655   2  =   TY=S*(Y-6);
656   2  =   CALL STOP$ERASE$VECTOR(TX,TY);
657   2  =   END; /*ERASE$HOSTILE$SYMBOL$2 */
         =
```

```
                =
                =
                =
658    1        =    ERASE$HOSTILE$DASH$2:PROCEDURE(X,Y,S) PUBLIC;
                =
                =    /* THIS PROCEDURE ERASES A DASHED DIAMOND WHICH
                =       REPRESENTS A HOSTILE SHIP.  */
                =
659    2        =    DCL (X,Y,TX,TY) ADDRESS;
660    2        =    DCL S BYTE;
661    2        =    IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
                =     THEN RETURN;   /* CAN NOT ERASE SYMBOL */
663    2        =    TX=S*(X);
664    2        =    TY=S*(Y+6);
665    2        =    CALL START$ERASE$DASH$2(TX,TY);
666    2        =    TX=S*(X-6);
667    2        =    TY=S*(Y);
668    2        =    CALL STOP$ERASE$DASH$2(TX,TY);
669    2        =    END; /*ERASE$HOSTILE$DASH$2 */
                =
                =
```

```
          =   /* END PLASMA PUBLICS FOR PLASMA DEVICE TWO. */
          =
          =
              $INCLUDE(:F1:UNKNOW.SR2)
          =
670   1   =   DRAW$UNKNOWN$SYMBOL$2:PROCEDURE (X,Y,S) PUBLIC;
          =
          =   /* THIS PROCEDURE DRAWS A SOLID SQUARE WHICH
          =      REPRESENTS AN UNKNOWN SHIP.       */
671   2   =   DCL (X,Y,TX,TY) ADDRESS;
672   2   =   DCL S BYTE;
673   2   =   IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
          =   THEN RETURN;  /* CAN NOT DRAW SYMBOL */
675   2   =   TX=S*(X-5);
676   2   =   TY=S*(Y-5);
677   2   =   CALL START$VECTOR$SOLID$2(TX,TY);
678   2   =   TX=S*(X+5);
679   2   =   TY=S*(Y-5);
680   2   =   CALL STOP$VECTOR$SOLID$2(TX,TY);
681   2   =   TX=S*(X+5);
682   2   =   TY=S*(Y+5);
```

```
683   2  =    CALL STOP$VECTOR$SOLID$2(TX,TY);
684   2  =    TX=S*(X-5);
685   2  =    TY=S*(Y+5);
686   2  =    CALL STOP$VECTOR$SOLID$2(TX,TY);
687   2  =    TX=S*(X-5);
688   2  =    TY =S*(Y-5);
689   2  =    CALL STOP$VECTOR$SOLID$2(TX,TY);
690   2  =    END; /* DRAW$UNKNOWN$SYMBOL$2 */
           =
           =
691   1  =    ERASE$UNKNOWN$SYMBOL$2:PROCEDURE (X,Y,S) PUBLIC;
           =
           =    /* THIS PROCEDURE ERASES A SOLID SQUARE WHICH
           =       REPRESENTS AN UNKNOWN SHIP.       */
692   2  =    DCL (X,Y,TX,TY) ADDRESS;
693   2  =    DCL S BYTE;
694   2  =    IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
           =    THEN RETURN;  /* CAN NOT ERASE SYMBOL */
696   2  =    TX=S*(X-5);
697   2  =    TY=S*(Y-5);
698   2  =    CALL START$ERASE$VECTOR$2(TX,TY);
```

```
 699   2  =    TX=S*(X+5);
 700   2  =    TY=S*(Y-5);
 701   2  =    CALL STOP$ERASE$VECTOR$2(TX,TY);
 702   2  =    TX=S*(X+5);
 703   2  =    TY=S*(Y+5);
 704   2  =    CALL STOP$ERASE$VECTOR$2(TX,TY);
 705   2  =    TX=S*(X-5);
 706   2  =    TY=S*(Y+5);
 707   2  =    CALL STOP$ERASE$VECTOR$2(TX,TY);
 708   2  =    TX=S*(X-5);
 709   2  =    TY =S*(Y-5);
 710   2  =    CALL STOP$ERASE$VECTOR$2(TX,TY);
 711   2  =    END; /* ERASE$UNKNOWN$SYMBOL$2 */
             =
             =
 712   1  =    DRAW$UNKNOWN$DASH$2:PROCEDURE (X,Y,S) PUBLIC;
             =
             =    /* THIS PROCEDURE DRAWS A DASH SQUARE WHICH
             =       REPRESENTS AN UNKNOWN SHIP.       */
 713   2  =    DCL (X,Y,TX,TY) ADDRESS;
 714   2  =    DCL S BYTE;
```

```
715   2  =   IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
           =   THEN RETURN;  /* CAN NOT DRAW SYMBOL */
717   2  =   TX=S*(X+5);
718   2  =   TY=S*(Y+5);
719   2  =   CALL START$VECTOR$DASH$2(TX,TY);
720   2  =   TX=S*(X-5);
721   2  =   TY=S*(Y+5);
722   2  =   CALL STOP$VECTOR$DASH$2(TX,TY);
723   2  =   END; /* DRAW$UNKNOWN$DASH$2 */
           =
           =
724   1  =   ERASE$UNKNOWN$DASH$2:PROCEDURE (X,Y,S) PUBLIC;
           =
           =   /* THIS PROCEDURE ERASES A DASHED SQUARE WHICH
           =      REPRESENTS AN UNKNOWN SHIP.       */
725   2  =   DCL (X,Y,TX,TY) ADDRESS;
726   2  =   DCL S BYTE;
727   2  =   IF (X<7) OR (X>504) OR (Y<7) OR (Y>504)
           =   THEN RETURN;  /* CAN NOT ERASE SYMBOL */
729   2  =   TX=S*(X+5);
730   2  =   TY=S*(Y+5);
```

```
 731   2  =    CALL START$ERASE$DASH$2(TX,TY);
 732   2  =    TX=S*(X-5);
 733   2  =    TY=S*(Y+5);
 734   2  =    CALL STOP$ERASE$DASH$2(TX,TY);
 735   2  =    END; /* ERASE$UNKNOWN$DASH$2 */


 736   1       END; /* PLASMA$MODULE */
```

MODULE INFORMATION:

```
     CODE AREA SIZE     = 1E5EH   7774D
     VARIABLE AREA SIZE = 014EH    334D
     MAXIMUM STACK SIZE = 0006H      6D
     1072 LINES READ
     0 PROGRAM ERROR(S)

END OF PL/M-80 COMPILATION
```

```
ISIS-II PL/M-80 V3.1 COMPILATION OF MODULE PLASMAPRIMITIVES
NO OBJECT MODULE REQUESTED
COMPILER INVOKED BY:  PLM80 :F1:PSPRIM.SRC NOOBJECT PAGEWIDTH(82) PA
GELENGTH(24) D
                    -ATE(MAY 1979) TITLE('MODULE PSPRIM.SRC')



   1            PLASMA$PRIMITIVES: DO;

                /*****************************************************
******
                *
                *    THIS MODULE CONTAINS THE PRIMITIVES FOR
                *     PLASMA DEVICE ONE AND PLASMA DEVICE TWO.
                *
                *    MDS I/O PORT ASSIGNMENTS:
                *         PLASMA DEVICE ONE: PORTS 4 AND 5.
                *         PLASMA DEVICE TWO: PORTS 8 AND 9.
                *
                *****************************************************
*******/
```

```
  2  1      DECLARE LIT LITERALLY 'LITERALLY',
                   DCL LIT 'DECLARE';

  3  1      DCL TRUE LIT '0FFH',
                 FALSE LIT '00H';

  4  1      DCL PLASMA$DATA$ONE      LIT '04H',   /* PLASMA DEVICE
 ONE */
                 PLASMA$STATUS$ONE    LIT '05H',  /* PLASMA DEVICE
ONE */
                 PLASMA$DATA$TWO     LIT '08H',  /* PLASMA DEVICE T
WO */
                 PLASMA$STATUS$TWO   LIT '09H',  /* PLASMA DEVICE T
WO */
                 RECEIVE$MASK     LIT '06H',
```

```
                    TRANSMIT$MASK     LIT '05H';

   5   1        DCL STATUS$A          LIT '04H',
                    RESET$ALL         LIT '00H',
                    OUT$BUSY          LIT '01H',
                    IN$BUSY           LIT '02H';

   6   1        DCL STX               LIT '02H',   /* START TEXT */
                    ETX               LIT '03H',   /* ENABLE TEXT */
                    CS                LIT '0CH',   /* CLEAR SCREEN */
                    CG                LIT '0EH',   /* CONSTRUCT GRAPH *
/
                    CV                LIT '0FH',   /* CLEAR VECTORS */
                    EOL               LIT '24H';   /* END OF LINE */

   7   1        DCL SET$ERASE         LIT '0100$0000B',
                    SET$DASHED        LIT '0001$0000B',
                    SET$END           LIT '0010$0000B';
```

```
                /*** PLASMA$PRIMITIVES$1: ***/



                /*****************************************************
**************
            -    ****
                *
                * SET$STATUS$PLASMA:
                *   THIS PROCEDURE IS USED TO SET THE STATUS LINE FOR
THE PLASMA.
                *   NOTE THAT THE LOGIC TO BE USED IS NEGATIVE.
                *
                * PARAMETERS:
                *   - STATUS.- ASCII CHARACTER USED TO DEFINE THE STAT
US LINE.
                *
                *****************************************************
**************
```

```
                -   ***/
   8   1        SET$STATUS$PLASMA: PROCEDURE (STATUS) PUBLIC;
   9   2           DCL STATUS BYTE;
  10   2           OUTPUT(PLASMA$STATUS$ONE) = NOT STATUS;
  11   2           END SET$STATUS$PLASMA;



                /*****************************************************
***************
                -   *****
                *
                * PLASMA$WRITE:
                *   THIS PROCEDURE IS USED TO SEND A CHARACTER TO THE
PLASMA DISPLAY
                -   .
                *
                * PARAMETERS:
                *   - CHAR.- ASCII CHARACTER DESIRED TO BE SENT.
                *
                *****************************************************
***************
                -   *****/
  12   1        PLASMA$WRITE: PROCEDURE (CHAR) PUBLIC;
```

```
  13   2          DCL CHAR BYTE;
  14   2          DO WHILE ((NOT INPUT(PLASMA$STATUS$ONE)) AND STATUS
$A) <> STATUS$
            -   A;
  15   3             END;          /* WAIT FOR PLASMA TO BE READY */
  16   2          CALL SET$STATUS$PLASMA(RESET$ALL);
  17   2          OUTPUT(PLASMA$DATA$ONE) = NOT CHAR;
  18   2          CALL SET$STATUS$PLASMA(OUT$BUSY);
  19   2          END PLASMA$WRITE;


               /*****************************************************
**************
            -   ******
               *
               * CLEAR$PLASMA:
               *   THIS PROCEDURE IS USED TO CLEAR THE PLASMA DISPLAY
.
               *
               *****************************************************
**************
            -   ******/
  20   1       CLEAR$PLASMA: PROCEDURE PUBLIC;
  21   2          CALL SET$STATUS$PLASMA(IN$BUSY);
```

```
  22   2          CALL SET$STATUS$PLASMA(RESET$ALL);
  23   2          CALL PLASMA$WRITE(CS);
  24   2          CALL PLASMA$WRITE(CV);
  25   2          CALL SET$STATUS$PLASMA(RESET$ALL);
  26   2          END CLEAR$PLASMA;


                /*****************************************************
**************
            -   *******
                *
                * PLASMA$WRITE$VECTOR:
                *   THIS PROCEDURE IS USED TO SEND A FOUR BYTE VECTOR
TO THE PLASMA.
                *
                * PARAMETERS:
                *   - A.- POINTER TO THE FOUR BYTE VECTOR DESIRED TO B
E SENT.
                *
                *****************************************************
**************
            -   ******/
  27   1       PLASMA$WRITE$VECTOR: PROCEDURE (A) PUBLIC;
  28   2          DCL A ADDRESS,
```

```
                    VECTOR BASED A (4) BYTE,
                    VPTR BYTE;
  29   2         DO VPTR = 0 TO 3;
  30   3            CALL PLASMA$WRITE(VECTOR(VPTR));
  31   3            END;
  32   2         END PLASMA$WRITE$VECTOR;


              /*****************************************************
**************
           -   *******
              *
              * PLASMA$PRINT$STRING:
              *   THIS PROCEDURE IS USED TO WRITE A GIVEN STRING IN
A GIVEN POSITI
           -   ON AT
              *   THE PLASMA DISPLAY.
              *
              * PARAMETERS:
              *   - COLUMN.- DENOTES THE COLUMN NUMBER DESIRED TO BE
 ADDRESSED.
              *   - ROW.- DENOTES THE ROW NUMBER DESIRED TO BE ADDRE
SSED.
              *   - POINTER.- POINTS TO THE FIRST BYTE OF THE STRING
 DESIRED TO BE
```

```
            -    DIS-
                 *      PLAYED. NOTE THAT TWO CONSECUTIVE '$' SIGNS MUST
 MARK THE END
            -    OF
                 *      THE STRING.
                 *
                 ***************************************************
***************
            -    *******/
  33   1       PLASMA$PRINT$STRING: PROCEDURE (COLUMN, ROW, POINTER)
PUBLIC;
  34   2          DCL POINTER ADDRESS,
                       BUFFER BASED POINTER (1) BYTE,
                       (COLUMN, ROW, COUNT) BYTE;
  35   2          COUNT = 0;
  36   2          CALL SET$STATUS$PLASMA(IN$BUSY);
  37   2          CALL SET$STATUS$PLASMA(RESET$ALL);
  38   2          CALL PLASMA$WRITE(STX);
  39   2          CALL PLASMA$WRITE(COLUMN);
  40   2          CALL PLASMA$WRITE(ROW);
  41   2          DO WHILE (BUFFER(COUNT) <> EOL ) OR (BUFFER(COUNT +
 1) <> EOL );
  42   3             CALL PLASMA$WRITE(BUFFER(COUNT));
  43   3             COUNT = COUNT + 1;
  44   3             END;
```

```
  45   2          CALL PLASMA$WRITE(ETX);
  46   2          CALL SET$STATUS$PLASMA(RESET$ALL);
  47   2          END PLASMA$PRINT$STRING;


                /*****************************************************
**************
            -   ********
                *
                * INITIALIZE$PLASMA:
                *   THIS PROCEDURE IS USED TO INITIALIZE THE PLASMA DI
SPLAY.
                *
                *****************************************************
**************
            -   *******/
  48   1       INITIALIZE$PLASMA: PROCEDURE PUBLIC;
  49   2          DCL BUFFER (*) BYTE DATA ('ON LINE.$$');
  50   2          CALL CLEAR$PLASMA;
  51   2          CALL PLASMA$PRINT$STRING(0, 2, .BUFFER);
  52   2          END INITIALIZE$PLASMA;
```

```
                /*****************************************************
**************
            -   ******
                *
                * SET$VECTOR:
                *   THIS PROCEDURE IS USED PREPARE TWO X AND Y VALUES
GIVEN INTO THE
            -    FOR-
                *   MAT REQUIRED BY THE PLASMA UNIT TO DEFINE A VECTOR
.
                * PARAMETERS:
                *   - X.- ADDRESS VALUE.
                *   - Y.- ADDRESS VALUE.
                *   - POINTER.- POINTS TO A FOUR BYTE VECTOR IN WHICH
THE X AND Y VA
            -   LUES
                *     WILL BE ARRANGED.
                *
                *****************************************************
**************
            -   *****/
  53   1       SET$VECTOR: PROCEDURE (X, Y, POINTER) PUBLIC;
  54   2          DCL (X, Y, POINTER) ADDRESS,
                      VECTOR BASED POINTER (4) BYTE;
  55   2          VECTOR(0) = CG;
```

```
 56   2          VECTOR(1), VECTOR(2), VECTOR(3) = 00H;
 57   2          VECTOR(1) = LOW(X) AND 07FH;
 58   2          VECTOR(2) = LOW(Y) AND 07FH;
 59   2          VECTOR(3) = HIGH(SHL(Y AND 180H, 3)) OR
                            HIGH(SHL(X AND 180H, 1));
 60   2          VECTOR(3) = VECTOR(3) AND NOT SET$ERASE;
 61   2          END SET$VECTOR;



 62   1       SET$VECTOR$1: PROCEDURE (X, Y, POINTER);
 63   2          DCL (X, Y, POINTER) ADDRESS,
                     VECTOR BASED POINTER (4) BYTE;
 64   2          VECTOR(0) = CG;
 65   2          VECTOR(1), VECTOR(2), VECTOR(3) = 00H;
 66   2          VECTOR(1) = LOW(X) AND 07FH;
 67   2          VECTOR(2) = LOW(Y) AND 07FH;
 68   2          VECTOR(3) = HIGH(SHL(Y AND 180H, 3)) OR
                            HIGH(SHL(X AND 180H, 1));
 69   2          END SET$VECTOR$1;
```

```
                /*****************************************************
**************
            -   *******
                *
                * START$VECTOR$SOLID:
                *   THIS PROCEDURE IS USED TO DEFINE A START POINT FOR
 A SOLID VECTO
            -   R.
                *
                * PARAMETERS:
                *   - X.- ADDRESS VALUE.
                *   - Y.- ADDRESS VALUE.
                *
                *****************************************************
**************
            -   ******/
  70   1       START$VECTOR$SOLID: PROCEDURE (X, Y) PUBLIC;
  71   2          DCL (X, Y) ADDRESS,
                      VECTOR (4) BYTE;
```

```
 72   2          CALL SET$VECTOR(X, Y, .VECTOR);
 73   2          VECTOR(3) = VECTOR(3) AND NOT SET$DASHED;
 74   2          VECTOR(3) = VECTOR(3) AND NOT SET$END;
 75   2          CALL PLASMA$WRITE$VECTOR(.VECTOR);
 76   2          END START$VECTOR$SOLID;


              /*****************************************************
**************
           -   *******
              *
              * STOP$VECTOR$SOLID:
              *   THIS PROCEDURE IS USED TO DEFINE A STOP POINT FOR
A SOLID VECTOR
           -   .
              *
              * PARAMETERS:
              *   - X.- ADDRESS VALUE.
              *   - Y.- ADDRESS VALUE.
              *
              *****************************************************
**************
           -   ******/
```

```
 77   1      STOP$VECTOR$SOLID: PROCEDURE (X, Y) PUBLIC;
 78   2         DCL (X, Y) ADDRESS,
                    VECTOR (4) BYTE;
 79   2         CALL SET$VECTOR(X, Y, .VECTOR);
 80   2         VECTOR(3) = VECTOR(3) AND NOT SET$DASHED;
 81   2         VECTOR(3) = VECTOR(3) OR SET$END;
 82   2         CALL PLASMA$WRITE$VECTOR(.VECTOR);
 83   2         END STOP$VECTOR$SOLID;


              /*****************************************************
*************
           -   *******
              *
              * START$VECTOR$DASH:
              *   THIS PROCEDURE IS USED TO DEFINE A START POINT FOR
 A DASHED VECT
           -   OR.
              *
              * PARAMETERS:
              *   - X.- ADDRESS VALUE.
              *   - Y.- ADDRESS VALUE.
```

```
                *
                ***********************************************************
**************
            -   *******/
  84   1        START$VECTOR$DASH: PROCEDURE (X, Y) PUBLIC;
  85   2           DCL (X, Y) ADDRESS,
                       VECTOR (4) BYTE;
  86   2           CALL SET$VECTOR(X, Y, .VECTOR);
  87   2           VECTOR(3) = VECTOR(3) OR SET$DASHED;
  88   2           VECTOR(3) = VECTOR(3) AND NOT SET$END;
  89   2           CALL PLASMA$WRITE$VECTOR(.VECTOR);
  90   2           END START$VECTOR$DASH;


                /***********************************************************
**************
            -   *******
                *
                * STOP$VECTOR$DASH:
                *   THIS PROCEDURE IS USED TO DEFINE A STOP POINT FOR
A DASHED VECTO
            -   R.
                *
```

```
                * PARAMETERS:
                *   - X.- ADDRESS VALUE.
                *   - Y.- ADDRESS VALUE.
                *
                ***********************************************************
**************
            -   *******/
  91   1        STOP$VECTOR$DASH: PROCEDURE (X, Y) PUBLIC;
  92   2           DCL (X, Y) ADDRESS,
                       VECTOR (4) BYTE;
  93   2           CALL SET$VECTOR(X, Y, .VECTOR);
  94   2           VECTOR(3) = VECTOR(3) OR SET$DASHED;
  95   2           VECTOR(3) = VECTOR(3) OR SET$END;
  96   2           CALL PLASMA$WRITE$VECTOR(.VECTOR);
  97   2           END STOP$VECTOR$DASH;


                /***********************************************************
**************
            -   *******
                *
                * GRAPHIC$DESIG:
```

```
                *   THIS PROCEDURE IS USED TO DISPLAY THE DESIGNATION
OF A CONTACT I
            -   N THE
                *   NEAREST POSSIBLE ALPHANUMERIC LOCATION TO THE X, Y
 VALUES GIVEN.
                *
                * PARAMETERS:
                *   - X.- ADDRESS VALUE.
                *   - Y.- ADDRESS VALUE.
                *   - DESIG.- POINTER TO THE DESIG OF A CONTACT.
                *
                ***********************************************************
**************
            -   *******/
  98   1       GRAPHIC$DESIG: PROCEDURE (X, Y, DESIG) PUBLIC;
  99   2          DCL (X, Y, DESIG) ADDRESS,
                      VALUE BASED DESIG ADDRESS,
                      BUFFER (6) BYTE,
                      (ROW, COLUMN) BYTE;
 100   2          BUFFER(0) = '[';
 101   2          BUFFER(1) = VALUE / 100;
 102   2          BUFFER(2) = VALUE MOD 100;
 103   2          BUFFER(3) = ']';
 104   2          BUFFER(4), BUFFER(5) = EOL;
```

```
 105   2          ROW = Y / 16;
 106   2          COLUMN = ((X - 14) / 6) - 5;
 107   2          IF X <= 8 THEN COLUMN = 0;
 109   2          IF (X >= 9) AND (X <= 44) THEN COLUMN = X / 6;
 111   2          IF (X >= 494) THEN COLUMN = 75;
 113   2          CALL PLASMA$PRINT$STRING(COLUMN, ROW, .BUFFER);
 114   2          END  GRAPHIC$DESIG;



                /**********************************************************
**********
                *
                *         START$ERASE$VECTOR :
                *
                **********************************************************
*********/

 115   1        START$ERASE$VECTOR : PROCEDURE (X,Y) PUBLIC ;
 116   2                DCL (X,Y) ADDRESS ,
                             VECTOR(4) BYTE;
 117   2               CALL SET$VECTOR$1 (X,Y, .VECTOR);
 118   2               VECTOR(3) = VECTOR(3) OR SET$ERASE;
```

```
 119   2              VECTOR(3)=VECTOR(3) AND NOT SET$DASHED;
 120   2              VECTOR(3)=VECTOR(3) AND NOT SET$END;
 121   2              CALL PLASMA$WRITE$VECTOR(.VECTOR);
 122   2          END START$ERASE$VECTOR;

                 /**************************************************************
*********
                 *
                 *
                 *          STOP$ERASE$VECTOR :
                 *
                 **************************************************************
*******/

 123   1        STOP$ERASE$VECTOR : PROCEDURE (X,Y) PUBLIC ;
 124   2             DCL (X,Y) ADDRESS ,
                        VECTOR (4) BYTE ;
 125   2             CALL SET$VECTOR$1 (X,Y, .VECTOR) ;
 126   2             VECTOR(3) = VECTOR(3) OR SET$EPASE;
 127   2             VECTOR(3)=VECTOR(3) AND NOT SET$DASHED ;
 128   2             VECTOR(3)=VECTOR(3) OR SET$END ;
 129   2             CALL PLASMA$WRITE$VECTOR(.VECTOR) ;
 130   2        END STOP$ERASE$VECTOR ;
```

```
                /*************************************************************
*********
                *
                *       START$ERASE$DASH:
                *
                *************************************************************
*********/

 131   1      START$ERASE$DASH: PROCEDURE (X,Y) PUBLIC;
 132   2              DCL (X,Y) ADDRESS,
                          VECTOR(4) BYTE;
 133   2              CALL SET$VECTOR$1 (X,Y, .VECTOR);
 134   2              VECTOR(3) = VECTOR(3) OR SET$ERASE;
 135   2              VECTOR(3) = VECTOR(3) OR SET$DASHED;
 136   2              VECTOR(3) = VECTOR(3) AND NOT SET$END;
 137   2              CALL PLASMA$WRITE$VECTOR(.VECTOR);
 138   2      END START$ERASE$DASH;
```

```
                /*****************************************************
*********
                *
                *        STOP$ERASE$DASH:
                *
                *****************************************************
*******/

 139   1        STOP$ERASE$DASH: PROCEDURE (X,Y) PUBLIC;
 140   2                DCL (X,Y) ADDRESS,
                                VECTOR (4) BYTE;
 141   2                CALL SET$VECTOR$1 (X,Y , .VECTOR);
 142   2                VECTOR(3) = VECTOR(3) OR SET$ERASE;
 143   2                VECTOR(3) = VECTOR(3) OR SET$DASHED;
 144   2                VECTOR(3) = VECTOR(3) OR SET$END;
 145   2                CALL PLASMA$WRITE$VECTOR( .VECTOR);
 146   2        END STOP$ERASE$DASH;


                /*** END PLASMA$PRIMITIVES$1: ***/
```

```
                $INCLUDE(:F1:PSPR2.SRC)
              =
              =     /*** PLASMA$PRIMITIVES$2: ***/
              =
              =
              =
              =
              =     /*************************************************************
**************
                -     ****
              =     *
              =     * SET$STATUS$PLASMA:
              =     *   THIS PROCEDURE IS USED TO SET THE STATUS LINE FOR
THE PLASMA.
              =     *   NOTE THAT THE LOGIC TO BE USED IS NEGATIVE.
              =     *
              =     * PARAMETERS:
              =     *   - STATUS.- ASCII CHARACTER USED TO DEFINE THE STAT
US LINE.
```

```
          =    *
          =    ***********************************************************
**************
           -    ***/
 147   1  =    SET$STATUS$PLASMA$2: PROCEDURE (STATUS) PUBLIC;
 148   2  =       DCL STATUS BYTE;
 149   2  =       OUTPUT(PLASMA$STATUS$TWO) = NOT STATUS;
 150   2  =       END SET$STATUS$PLASMA$2;
          =
          =
          =
          =    /***********************************************************
**************
           -    *****
          =    *
          =    * PLASMA$WRITE:
          =    *   THIS PROCEDURE IS USED TO SEND A CHARACTER TO THE
PLASMA DISPLAY
           -    .
          =    *
          =    * PARAMETERS:
          =    *   - CHAR.- ASCII CHARACTER DESIRED TO BE SENT.
          =    *
          =    ***********************************************************
**************
```

```
            -   *****/
 151   1  =   PLASMA$WRITE$2: PROCEDURE (CHAR) PUBLIC;
 152   2  =      DCL CHAR BYTE;
 153   2  =      DO WHILE ((NOT INPUT(PLASMA$STATUS$TWO)) AND STATUS
$A) <> STATUS$
            -   A;
 154   3  =         END;          /* WAIT FOR PLASMA TO BE READY */
 155   2  =      CALL SET$STATUS$PLASMA$2(RESET$ALL);
 156   2  =      OUTPUT(PLASMA$DATA$TWO) = NOT CHAR;
 157   2  =      CALL SET$STATUS$PLASMA$2(OUT$BUSY);
 158   2  =      END PLASMA$WRITE$2;
          =
          =
          =
          =   /*****************************************************
**************
            -   ******
          =   *
          =   * CLEAR$PLASMA:
          =   *   THIS PROCEDURE IS USED TO CLEAR THE PLASMA DISPLAY
.
          =   *
          =   *****************************************************
**************
            -   ******/
```

```
 159   1   =    CLEAR$PLASMA$2: PROCEDURE PUBLIC;
 160   2   =       CALL SET$STATUS$PLASMA$2(IN$BUSY);
 161   2   =       CALL SET$STATUS$PLASMA$2(RESET$ALL);
 162   2   =       CALL PLASMA$WRITE$2(CS);
 163   2   =       CALL PLASMA$WRITE$2(CV);
 164   2   =       CALL SET$STATUS$PLASMA$2(RESET$ALL);
 165   2   =       END CLEAR$PLASMA$2;
             =
             =
             =
             =    /**************************************************************
**************
               -    *******
             =    *
             =    * PLASMA$WRITE$VECTOR:
             =    *   THIS PROCEDURE IS USED TO SEND A FOUR BYTE VECTOR
TO THE PLASMA.
             =    *
             =    * PARAMETERS:
             =    *   - A.- POINTER TO THE FOUR BYTE VECTOR DESIRED TO B
E SENT.
             =    *
             =    **************************************************************
**************
               -    ******/
```

```
 166   1   =    PLASMA$WRITE$VECTOR$2: PROCEDURE (A) PUBLIC;
 167   2   =       DCL A ADDRESS,
             =           VECTOR BASED A (4) BYTE,
             =           VPTR BYTE;
 168   2   =       DO VPTR = 0 TO 3;
 169   3   =          CALL PLASMA$WRITE$2(VECTOR(VPTR));
 170   3   =          END;
 171   2   =       END PLASMA$WRITE$VECTOR$2;
             =
             =
             =
             =    /**************************************************************
*************
              -    *******
             =    *
             =    * PLASMA$PRINT$STRING:
             =    *   THIS PROCEDURE IS USED TO WRITE A GIVEN STRING IN
A GIVEN POSITI
              -    ON AT
             =    *   THE PLASMA DISPLAY.
             =    *
             =    * PARAMETERS:
             =    *   - COLUMN.- DENOTES THE COLUMN NUMBER DESIRED TO BE
 ADDRESSED.
```

```
          =    *    - ROW.- DENOTES THE ROW NUMBER DESIRED TO BE ADDRE
SSED.
          =    *    - POINTER.- POINTS TO THE FIRST BYTE OF THE STRING
 DESIRED TO BE
           -     DIS-
          =    *      PLAYED. NOTE THAT TWO CONSECUTIVE '$' SIGNS MUST
 MARK THE END
           -     OF
          =    *      THE STRING.
          =    *
          =    ***********************************************************
*************
           -    *******/
 172   1  =    PLASMA$PRINT$STRING$2: PROCEDURE (COLUMN, ROW, POINTER
) PUBLIC;
 173   2  =       DCL POINTER ADDRESS,
          =           BUFFER BASED POINTER (1) BYTE,
          =           (COLUMN, ROW, COUNT) BYTE;
 174   2  =       COUNT = 0;
 175   2  =       CALL SET$STATUS$PLASMA$2(IN$BUSY);
 176   2  =       CALL SET$STATUS$PLASMA$2(RESET$ALL);
 177   2  =       CALL PLASMA$WRITE$2(STX);
 178   2  =       CALL PLASMA$WRITE$2(COLUMN);
 179   2  =       CALL PLASMA$WRITE$2(ROW);
 180   2  =       DO WHILE (BUFFER(COUNT) <> EOL ) OR (BUFFER(COUNT +
 1) <> EOL );
 181   3  =          CALL PLASMA$WRITE$2(BUFFER(COUNT));
```

```
 182   3  =          COUNT = COUNT + 1;
 183   3  =          END;
 184   2  =       CALL PLASMA$WRITE$2(ETX);
 185   2  =       CALL SET$STATUS$PLASMA$2(RESET$ALL);
 186   2  =       END PLASMA$PRINT$STRING$2;
          =
          =
          =
          =    /*****************************************************
**************
           -    ********
          =    *
          =    * INITIALIZE$PLASMA:
          =    *   THIS PROCEDURE IS USED TO INITIALIZE THE PLASMA DI
SPLAY.
          =    *
          =    *****************************************************
**************
           -    *******/
 187   1  =    INITIALIZE$PLASMA$2: PROCEDURE PUBLIC;
 188   2  =       DCL BUFFER (*) BYTE DATA ('ON LINE.$$');
 189   2  =       CALL CLEAR$PLASMA$2;
 190   2  =       CALL PLASMA$PRINT$STRING$2(0, 2, .BUFFER);
 191   2  =       END INITIALIZE$PLASMA$2;
```

```
          =
          =
          =
          =   /*****************************************************
**************
           -   ******
          =   *
          =   * SET$VECTOR:
          =   *   THIS PROCEDURE IS USED PREPARE TWO X AND Y VALUES
GIVEN INTO THE
           -    FOR-
          =   *   MAT REQUIRED BY THE PLASMA UNIT TO DEFINE A VECTOR
.
          =   * PARAMETERS:
          =   *   - X.- ADDRESS VALUE.
          =   *   - Y.- ADDRESS VALUE.
          =   *   - POINTER.- POINTS TO A FOUR BYTE VECTOR IN WHICH
THE X AND Y VA
           -   LUES
          =   *     WILL BE ARRANGED.
          =   *
          =   *****************************************************
**************
           -   *****/
 192   1  =   SET$VECTOR$2: PROCEDURE (X, Y, POINTER) PUBLIC;
 193   2  =      DCL (X, Y, POINTER) ADDRESS,
```

```
                =           VECTOR BASED POINTER (4) BYTE;
194    2        =       VECTOR(0) = CG;
195    2        =       VECTOR(1), VECTOR(2), VECTOR(3) = 00H;
196    2        =       VECTOR(1) = LOW(X) AND 07FH;
197    2        =       VECTOR(2) = LOW(Y) AND 07FH;
198    2        =       VECTOR(3) = HIGH(SHL(Y AND 180H, 3)) OR
                =                   HIGH(SHL(X AND 180H, 1));
199    2        =       VECTOR(3) = VECTOR(3) AND NOT SET$ERASE;
200    2        =       END SET$VECTOR$2;
                =
                =
                =
                =
201    1        =   SET$VECTOR$1$2: PROCEDURE (X, Y, POINTER);
202    2        =      DCL (X, Y, POINTER) ADDRESS,
                =          VECTOR BASED POINTER (4) BYTE;
203    2        =      VECTOR(0) = CG;
204    2        =      VECTOR(1), VECTOR(2), VECTOR(3) = 00H;
205    2        =      VECTOR(1) = LOW(X) AND 07FH;
206    2        =      VECTOR(2) = LOW(Y) AND 07FH;
207    2        =      VECTOR(3) = HIGH(SHL(Y AND 180H, 3)) OR
```

```
          =                    HIGH(SHL(X AND 180H, 1));
 208   2  =       END SET$VECTOR$1$2;
          =
          =
          =
          =
          =
          =    /*****************************************************
**************
           -    *******
          =    *
          =    * START$VECTOR$SOLID:
          =    *   THIS PROCEDURE IS USED TO DEFINE A START POINT FOR
 A SOLID VECTO
           -    R.
          =    *
          =    * PARAMETERS:
          =    *   - X.- ADDRESS VALUE.
          =    *   - Y.- ADDRESS VALUE.
          =    *
          =    *****************************************************
**************
           -    ******/
 209   1  =    START$VECTOR$SOLID$2: PROCEDURE (X, Y) PUBLIC;
```

```
 210   2  =      DCL (X, Y) ADDRESS,
          =          VECTOR (4) BYTE;
 211   2  =      CALL SET$VECTOR$2(X, Y, .VECTOR);
 212   2  =      VECTOR(3) = VECTOR(3) AND NOT SET$DASHED;
 213   2  =      VECTOR(3) = VECTOR(3) AND NOT SET$END;
 214   2  =      CALL PLASMA$WRITE$VECTOR$2(.VECTOR);
 215   2  =      END START$VECTOR$SOLID$2;
          =
          =
          =
          =   /*****************************************************
**************
           -   *******
          =   *
          =   * STOP$VECTOR$SOLID:
          =   *   THIS PROCEDURE IS USED TO DEFINE A STOP POINT FOR
A SOLID VECTOR
           -   .
          =   *
          =   * PARAMETERS:
          =   *   - X.- ADDRESS VALUE.
          =   *   - Y.- ADDRESS VALUE.
          =   *
```

```
          =   ***************************************************
*************
           -   ******/
 216   1  =   STOP$VECTOR$SOLID$2: PROCEDURE (X, Y) PUBLIC;
 217   2  =      DCL (X, Y) ADDRESS,
          =          VECTOR (4) BYTE;
 218   2  =      CALL SET$VECTOR$2(X, Y, .VECTOR);
 219   2  =      VECTOR(3) = VECTOR(3) AND NOT SET$DASHED;
 220   2  =      VECTOR(3) = VECTOR(3) OR SET$END;
 221   2  =      CALL PLASMA$WRITE$VECTOR$2(.VECTOR);
 222   2  =      END STOP$VECTOR$SOLID$2;
          =
          =
          =
          =   /***************************************************
*************
           -   *******
          =   *
          =   * START$VECTOR$DASH:
          =   *   THIS PROCEDURE IS USED TO DEFINE A START POINT FOR
 A DASHED VECT
           -   OR.
          =   *
          =   * PARAMETERS:
```

```
            =    *    - X.- ADDRESS VALUE.
            =    *    - Y.- ADDRESS VALUE.
            =    *
            =    ***********************************************************
**************
             -    *******/
 223    1   =    START$VECTOR$DASH$2: PROCEDURE (X, Y) PUBLIC;
 224    2   =       DCL (X, Y) ADDRESS,
            =           VECTOR (4) BYTE;
 225    2   =       CALL SET$VECTOR$2(X, Y, .VECTOR);
 226    2   =       VECTOR(3) = VECTOR(3) OR SET$DASHED;
 227    2   =       VECTOR(3) = VECTOR(3) AND NOT SET$END;
 228    2   =       CALL PLASMA$WRITE$VECTOR$2(.VECTOR);
 229    2   =       END START$VECTOR$DASH$2;
            =
            =
            =
            =    /***********************************************************
***************
             -    *******
            =    *
            =    * STOP$VECTOR$DASH:
            =    *   THIS PROCEDURE IS USED TO DEFINE A STOP POINT FOR
A DASHED VECTO
```

```
          -   R.
         =   *
         =   * PARAMETERS:
         =   *   - X.- ADDRESS VALUE.
         =   *   - Y.- ADDRESS VALUE.
         =   *
         =   ***********************************************************
**************
          -   *******/
 230   1  =   STOP$VECTOR$DASH$2: PROCEDURE (X, Y) PUBLIC;
 231   2  =      DCL (X, Y) ADDRESS,
         =          VECTOR (4) BYTE;
 232   2  =      CALL SET$VECTOR$2(X, Y, .VECTOR);
 233   2  =      VECTOR(3) = VECTOR(3) OR SET$DASHED;
 234   2  =      VECTOR(3) = VECTOR(3) OR SET$END;
 235   2  =      CALL PLASMA$WRITE$VECTOR$2(.VECTOR);
 236   2  =      END STOP$VECTOR$DASH$2;
         =
         =
         =
         =   /***********************************************************
**************
          -   *******
```

```
           =    *
           =    * GRAPHIC$DESIG:
           =    *   THIS PROCEDURE IS USED TO DISPLAY THE DESIGNATION
OF A CONTACT I
            -    N THE
           =    *   NEAREST POSSIBLE ALPHANUMERIC LOCATION TO THE X, Y
 VALUES GIVEN.
           =    *
           =    * PARAMETERS:
           =    *   - X.- ADDRESS VALUE.
           =    *   - Y.- ADDRESS VALUE.
           =    *   - DESIG.- POINTER TO THE DESIG OF A CONTACT.
           =    *
           =    ***************************************************************
**************
            -    *******/
 237   1   =    GRAPHIC$DESIG$2: PROCEDURE (X, Y, DESIG) PUBLIC;
 238   2   =       DCL (X, Y, DESIG) ADDRESS,
           =           VALUE BASED DESIG ADDRESS,
           =           BUFFER (6) BYTE,
           =           (ROW, COLUMN) BYTE;
 239   2   =       BUFFER(0) = '[';
 240   2   =       BUFFER(1) = VALUE / 100;
 241   2   =       BUFFER(2) = VALUE MOD 100;
```

```
 242   2  =       BUFFER(3) = ']';
 243   2  =       BUFFER(4), BUFFER(5) = EOL;
 244   2  =       ROW = Y / 16;
 245   2  =       COLUMN = ((X - 14) / 6) - 5;
 246   2  =       IF X <= 8 THEN COLUMN = 0;
 248   2  =       IF (X >= 9) AND (X <= 44) THEN COLUMN = X / 6;
 250   2  =       IF (X >= 494) THEN COLUMN = 75;
 252   2  =       CALL PLASMA$PRINT$STRING$2(COLUMN, ROW, .BUFFER);
 253   2  =       END  GRAPHIC$DESIG$2;
            =
            =
            =
            =   /**********************************************************
**********
            =   *
            =   *         START$ERASE$VECTOR :
            =   *
            =   **********************************************************
*********/
            =
 254   1  =   START$ERASE$VECTOR$2: PROCEDURE (X,Y) PUBLIC ;
 255   2  =           DCL (X,Y) ADDRESS ,
            =                 VECTOR(4) BYTE;
```

```
 256   2  =          CALL SET$VECTOR$1$2 (X,Y, .VECTOR);
 257   2  =          VECTOR(3) = VECTOR(3) OR SET$ERASE;
 258   2  =          VECTOR(3)=VECTOR(3) AND NOT SET$DASHED;
 259   2  =          VECTOR(3)=VECTOR(3) AND NOT SET$END;
 260   2  =          CALL PLASMA$WRITE$VECTOR$2(.VECTOR);
 261   2  =      END START$ERASE$VECTOR$2;
          =
          =   /*****************************************************
*********
          =   *
          =   *
          =   *        STOP$ERASE$VECTOR :
          =   *
          =   *****************************************************
*******/
          =
 262   1  =   STOP$ERASE$VECTOR$2: PROCEDURE (X,Y) PUBLIC ;
 263   2  =        DCL (X,Y) ADDRESS ,
          =             VECTOR (4) BYTE ;
 264   2  =        CALL SET$VECTOR$1$2 (X,Y, .VECTOR) ;
 265   2  =        VECTOR(3) = VECTOR(3) OR SET$ERASE;
 266   2  =        VECTOR(3)=VECTOR(3) AND NOT SET$DASHED ;
 267   2  =        VECTOR(3)=VECTOR(3) OR SET$END ;
```

```
 268   2  =        CALL PLASMA$WRITE$VECTOR$2(.VECTOR) ;
 269   2  =    END STOP$ERASE$VECTOR$2;
            =
            =
            =
            =
            =    /*************************************************************
**********
            =    *
            =    *         START$ERASE$DASH:
            =    *
            =    *************************************************************
**********/
            =
 270   1  =    START$ERASE$DASH$2: PROCEDURE (X,Y) PUBLIC;
 271   2  =             DCL (X,Y) ADDRESS,
            =                    VECTOR (4) BYTE;
 272   2  =              CALL SET$VECTOR$1$2 (X,Y, .VECTOR);
 273   2  =              VECTOR(3) = VECTOR(3) OR SET$ERASE;
 274   2  =              VECTOR(3) = VECTOR(3) OR SET$DASHED;
 275   2  =              VECTOR(3) = VECTOR(3) AND NOT SET$END;
 276   2  =              CALL PLASMA$WRITE$VECTOR$2(.VECTOR);
 277   2  =      END START$ERASE$DASH$2;
```

```
                =
                =
                =   /*****************************************************
*******
                =   *
                =   *
                =   *        STOP$ERASE$DASH:
                =   *
                =   *****************************************************
******/
                =
 278    1       =   STOP$ERASE$DASH$2: PROCEDURE (X,Y) PUBLIC;
 279    2       =           DCL (X,Y) ADDRESS,
                =                VECTOR (4) BYTE;
 280    2       =           CALL SET$VECTOR$1$2 (X,Y,.VECTOR);
 281    2       =           VECTOR(3) = VECTOR(3) OR SET$ERASE;
 282    2       =           VECTOR(3) = VECTOR(3) OR SET$DASHED;
 283    2       =           VECTOR(3) = VECTOR(3) OR SET$END;
 284    2       =           CALL PLASMA$WRITE$VECTOR$2(.VECTOR);
 285    2       =     END STOP$ERASE$DASH$2;
                =
                =
                =
```

```
        =
        =   /*** END PLASMA$PRIMITIVES$2 ***/



 286  1      END PLASMA$PRIMITIVES;


MODULE INFORMATION:

     CODE AREA SIZE     = 082CH   2092D
     VARIABLE AREA SIZE = 00C8H    200D
     MAXIMUM STACK SIZE = 0006H      6D
     789 LINES READ
     0 PROGRAM ERROR(S)

END OF PL/M-80 COMPILATION
```

```
struct  {
          int lat[10] ;
          int longtd[10] ;
          int course [10] ;
          char speed[10] ;
          int xbow[10] ;
          int ybow[10] ;
          char quadrant[10] ;
          int range[10] ;
          int bearing[10] ;
          char collflag[10] ;
          int cpatime[10] ;
          int cpadist[10] ;
          char count;
        } shipplot[5], *shipptr;


struct  {
          int xtail[10] ;
          int ytail[10] ;
          int rangtail[10];
          int beartail[10];
        } back[5] ;


abs() ;
double fabs() ;
double atan() ;
```

```
double pow()  ;
double sqrt() ;
double sin() ;
double cos() ;


 float baselat,baselong,latoff,longoff ;
int fx1,fy1,fx2,fy2,fx0,fy0;
int hx1,hy1,hx2,hy2,hx3,hy3,hx0,hy0;
int ux1,uy1,ux0,uy0;
int fsp1,fsp2,fsp0,hsp1,hsp2,hsp3,hsp0,usp1,usp0;

int sp10 10;
int sp20 20;
int sp30 30;
int sp40 40;
int intct; /* structure initialization counter */
int times; /* sets counter increment */

char backship 0;
char cpact;

   char c,d,e,z;
   int k,e0,f0;
char cr 015;
char lf 012;
int bitx7 000200;
int bitx14 040000;
```

```
main()
{
sleep(120);
init0();
cpact = 0;
baselat = 40.0 ;
baselong = 40.0 ;
latoff =  0.05 ;
longoff = 0.05 ;
intct = 0;
times = 1;
/* zero xtail and ytail */
for (c=0;c<3;c++)
{
    for (d=0;d<10;d++)
    {
     back[c].xtail[d] = 1000;
     back[c].ytail[d] = 1000;
     back[c].rangtail[d]=1000;
     back[c].beartail[d]=1000;
    }
}
/* initialize structure positions and speed */
fx0=431;
fy0=411;
fx1=401;
fy1=411;
fx2=401;
fy2=411;
```

```
hx0=192;
hy0=288;
hx1=168;
hy1=288;
hx2=168;
hy2=308;
hx3=192;
hy3=308;
ux0=40;
uy1=248;
ux1=490;
uy0=265;
fsp0=sp20;
fsp1=sp20;
fsp2=sp20;
hsp0=sp10;
hsp1=sp10;
hsp2=sp10;
hsp3=sp10;
usp0=sp20;
usp1=sp20;
while (1)
{
d='2';
putchar(d);
if ((d=getchar())=='&')
{
d=getchar();
initstru();
compute() ;
```

```
senddata();
eot();
sleep(120);
}
}
}



initstru()
{

/* this a procedure to initialize structure to test module stand-alone. */
int fix0,fiy0,fix1,fiy1,fix2,fiy2;
int hix0,hiy0,hix1,hiy1,hix2,hiy2,hix3,hiy3;
int uix0,uiy0,uix1,uiy1;
shipplot[0].speed[0]=fsp0;
shipplot[0].speed[1]=fsp1;
shipplot[0].speed[2]=fsp2;
shipplot[1].speed[0]=hsp0;
shipplot[1].speed[1]=hsp1;
shipplot[1].speed[2]=hsp2;
shipplot[1].speed[3]=hsp3;
shipplot[2].speed[0]=usp0;
shipplot[2].speed[1]=usp1;
shipplot[0].count=3;
shipplot[1].count=4;
shipplot[2].count=2;
shipplot[0].xbow[0]=fx0;
shipplot[0].xbow[1]=fx1;
```

```
shipplot[0].xbow[2]=fx2;
shipplot[1].xbow[0]=hx0;
shipplot[1].xbow[1]=hx1;
shipplot[1].xbow[2]=hx2;
shipplot[1].xbow[3]=hx3;
shipplot[2].xbow[0]=ux0;
shipplot[2].xbow[1]=ux1;
shipplot[0].ybow[0]=fy0;
shipplot[0].ybow[1]=fy1;
shipplot[0].ybow[2]=fy2;
shipplot[1].ybow[0]=hy0;
shipplot[1].ybow[1]=hy1;
shipplot[1].ybow[2]=hy2;
shipplot[1].ybow[3]=hy3;
shipplot[2].ybow[0]=uy0;
shipplot[2].ybow[1]=uy1;
shipplot[0].quadrant[0]=quadnum(shipplot[0].xbow[0],shipplot[0].ybow[0]);
shipplot[0].quadrant[1]=quadnum(shipplot[0].xbow[1],shipplot[0].ybow[1]);
shipplot[0].quadrant[2]=quadnum(shipplot[0].xbow[2],shipplot[0].ybow[2]);
shipplot[1].quadrant[0]=quadnum(shipplot[1].xbow[0],shipplot[1].ybow[0]);
shipplot[1].quadrant[1]=quadnum(shipplot[1].xbow[1],shipplot[1].ybow[1]);
shipplot[1].quadrant[2]=quadnum(shipplot[1].xbow[2],shipplot[1].ybow[2]);
shipplot[1].quadrant[3]=quadnum(shipplot[1].xbow[3],shipplot[1].ybow[3]);
shipplot[2].quadrant[0]=quadnum(shipplot[2].xbow[0],shipplot[2].ybow[0]);
shipplot[2].quadrant[1]=quadnum(shipplot[2].xbow[1],shipplot[2].ybow[1]);

/* increment data points for all contacts */
if (intct < 8)
   {
   fix0=fix1=fix2=2;
```

```
        fiy0=fiy1=fiy2= -1;
        hix0=hix1=hix2=hix3=1;
        hiy0=hiy1=hiy2=hiy3= -1;
        uix0=0;
        uiy0=2;
        uix1= -1;
        uiy1= -2;
        }
    else
    if (intct < 22)
        {
        fix0=fix1=fix2=0;
        fiy0=fiy1=fiy2= -3;
        hix0=hix1=hix2=hix3=0;
        hiy0=hiy1=hiy2=hiy3= -2;
        uix0=0;
        uiy0=2;
        uix1= -1;
        uiy1= -2;
        hsp0=hsp1=hsp2=hsp3=sp20;
        fsp0=fsp1=fsp2=sp30;
        }
    else
        {
        fix0=fix1=fix2= -3;
        fiy0=fiy1=fiy2= -3;
        hix0=hix1=hix2=hix3= -3;
        hiy0=hiy1=hiy2=hiy3= -3;
        uix0=0;
        uiy0=2;
```

```
    uix1= -1;
    uiy1= -2;
    fsp0=fsp1=fsp2=40;
    hsp0=hsp1=hsp2=hsp3=30;
    }


fx0=fix0 + fx0;
fy0=fiy0 + fy0;
fx1=fix1 + fx1;
fy1=fiy1 + fy1;
fx2=fix2 + fx2;
fy2=fiy2 + fy2;
hx0=hix0 + hx0;
hy0=hiy0 + hy0;
hx1=hix1 + hx1;
hy1=hiy1 + hy1;
hx2=hix2 + hx2;
hy2=hiy2 + hy2;
hx3=hix3 + hx3;
hy3=hiy3 + hy3;
ux0=uix0 + ux0;
uy0=uiy0 +uy0;
ux1=uix1 + ux1;
uy1=uiy1 + uy1;

intct = intct + (times * 1);
} /* initstru */
```

```
init0()
{
 char d,e;
 for (e=0;e<3;e++)
 {
  shipplot[e].count=0;
   for(d=0;d<10;d++)
   {
     shipplot[e].lat[d]=0;
     shipplot[e].longtd[d]=0;
     shipplot[e].course[d]=0;
     shipplot[e].speed[d]=0;
     shipplot[e].xbow[d]=0;
     shipplot[e].ybow[d]=0;
     shipplot[e].quadrant[d]=0;
     shipplot[e].range[d]=0;
     shipplot[e].bearing[d]=0;
     shipplot[e].collflag[d]=0;
     shipplot[e].cpatime[d]=0;
     shipplot[e].cpadist[d]=0;
   }
  }
}



senddata()
{
 char d,e;
```

```
d = '0';
putchar(d);
for (e=0;e<3;e++)
{
  for(d=0;d<10;d++)
  {
    if ((shipplot[e].lat[d] & bitx7 ) > 0)
      shipplot[e].lat[d] = (shipplot[e].lat[d] | bitx14);
    z=(shipplot[e].lat[d]);
    write(1,&z,1);
    z=(shipplot[e].lat[d]>>8);
    write(1,&z,1);
  }
  for(d=0;d<10;d++)
  {
    if ((shipplot[e].longtd[d] & bitx7) > 0)
      shipplot[e].longtd[d] = (shipplot[e].longtd[d] | bitx14);
    z=(shipplot[e].longtd[d]);
    write(1,&z,1);
    z=(shipplot[e].longtd[d]>>8);
    write(1,&z,1);
   }
  for(d=0;d<10;d++)
  {
    if ((shipplot[e].course[d] & bitx7) > 0)
      shipplot[e].course[d] = (shipplot[e].course[d] | bitx14);
    z=(shipplot[e].course[d]);
    write(1,&z,1);
    z=(shipplot[e].course[d]>>8);
    write(1,&z,1);
```

```
 }
for(d=0;d<10;d++)
{
  z=(shipplot[e].speed[d]);
  write(1,&z,1);
}
for(d=0;d<10;d++)
{
  if ((shipplot[e].xbow[d] & bitx7) > 0)
    shipplot[e].xbow[d] = (shipplot[e].xbow[d] | bitx14);
  z=(shipplot[e].xbow[d]);
  write(1,&z,1);
  z= (shipplot[e].xbow[d]>>8);
  write(1,&z,1);
}
for(d=0;d<10;d++)
{
  if ((shipplot[e].ybow[d] & bitx7) > 0)
    shipplot[e].ybow[d] = (shipplot[e].ybow[d] | bitx14);
  z=(shipplot[e].ybow[d]);
  write(1,&z,1);
  z = (shipplot[e].ybow[d]>>8);
  write(1,&z,1);
}
for(d=0;d<10;d++)
{
  z=(shipplot[e].quadrant[d]);
  write(1,&z,1);
}
for(d=0;d<10;d++)
```

```
{
  if ((shipplot[e].range[d] & bitx7) > 0)
    shipplot[e].range[d] = (shipplot[e].range[d] | bitx14);
  z=(shipplot[e].range[d]);
  write(1,&z,1);
  z = (shipplot[e].range[d]>>8);
  write(1,&z,1);
}
for(d=0;d<10;d++)
{
  if ((shipplot[e].bearing[d] & bitx7) > 0)
    shipplot[e].bearing[d] = (shipplot[e].bearing[d] | bitx14);
  z=(shipplot[e].bearing[d]);
  write(1,&z,1);
  z = (shipplot[e].bearing[d]>>8);
  write(1,&z,1);
}
for(d=0;d<10;d++)
{
  z=(shipplot[e].collflag[d]);
  write(1,&z,1);
}
for(d=0;d<10;d++)
{
  if ((shipplot[e].cpatime[d] & bitx7) > 0)
    shipplot[e].cpatime[d] = (shipplot[e].cpatime[d] | bitx14);
  z=(shipplot[e].cpatime[d]);
  write(1,&z,1);
  z = (shipplot[e].cpatime[d]>>8);
  write(1,&z,1);
```

```
    }
    for(d=0;d<10;d++)
    {
      if ((shipplot[e].cpadist[d] & bitx7) > 0)
        shipplot[e].cpadist[d] = (shipplot[e].cpadist[d] | bitx14);
      z=(shipplot[e].cpadist[d]);
      write(1,&z,1);
      z = (shipplot[e].cpadist[d]>>8);
      write(1,&z,1);
    }
   z=(shipplot[e].count);
   write(1,&z,1);
   }
}


init30()
{
 char d,e;
 for (e=0;e<3;e++)
 {
  shipplot[e].count=0o1;
   for(d=0;d<10;d++)
   {
     shipplot[e].lat[d]=030062;
     shipplot[e].longtd[d]=030062;
     shipplot[e].course[d]=030062;
     shipplot[e].speed[d]=061;
     shipplot[e].xbow[d]=030062;
     shipplot[e].ybow[d]=030062;
```

```
        shipplot[e].quadrant[d]=061;
        shipplot[e].range[d]=061;
        shipplot[e].bearing[d]=030062;
        shipplot[e].collflag[d]=061;
        shipplot[e].cpatime[d]=030062;
        shipplot[e].cpadist[d]=030062;
      }
    }
}



eot()

{putchar(cr);
 putchar(lf);
 putchar('%');
}



quadnum(x,y)
int x,y;
{
char a;
if ((x>=0) && (x<=127))
{
  if ((y>=0) && (y<=127))
      a=1;
  else
```

```
    if ((y>=128) && (y<=255))
        a=5;
    else
    if ((y>=256) && (y<=383))
        a=9;
    else
    if ((y>=384) && (y<=511))
        a=13;
}
else
if ((x>=128) && (x<=255))
{
    if ((y>=0) && (y<=127))
        a=2;
    else
    if ((y>=128) && (y<=255))
        a=6;
    else
    if ((y>=256) && (y<=383))
        a=10;
    else
    if ((y>=384) && (y<=511))
        a=14;
}
else

if ((x>=256) && (x<=383))
{
    if ((y>=0) && (y<=127))
        a=3;
```

```
    else
    if ((y>=128) && (y<=255))
        a=7;
    else
    if ((y>=256) && (y<=383))
        a=11;
    else
    if ((y>=384) && (y<=511))
        a=15;
}
else

if ((x>=384) && (x<=511))
{
    if ((y>=0) && (y<=127))
        a=4;
    else
    if ((y>=128) && (y<=255))
        a=8;
    else
    if ((y>=256) && (y<=383))
        a=12;
    else
    if ((y>=384) && (y<=511))
        a=16;
}

return a ;
} /* quadnum */
```

```
initck()
{
 char d,e;
 for (e=0;e<3;e++)
 {
  shipplot[e].count='c';
   for(d=0;d<10;d++)
   {
     shipplot[e].lat[d]='00';
     shipplot[e].longtd[d]='11';
     shipplot[e].course[d]='22';
     shipplot[e].speed[d]='3';
     shipplot[e].xbow[d]='44';
     shipplot[e].ybow[d]='55';
     shipplot[e].quadrant[d]='6';
     shipplot[e].range[d]='77';
     shipplot[e].bearing[d]='88';
     shipplot[e].collflag[d]='9';
     shipplot[e].cpatime[d]='aa';
     shipplot[e].cpadist[d]='bb';
   }
  }
}
```

```
compute()

/* calls subroutines to load contact statistical data */
{
int i,j ;
j=0 ;
for (i=0;i<5;i++)
{
  if (shipplot[i].count > 0)
  {
    while(j<shipplot[i].count)
    {
      ldlat(i,j) ;
      ldlong(i,j) ;
      ldcour(i,j) ;
      if ((i==0) && (j==1)) j=j ;
      else
      {
        ldrang(i,j) ;
        ldbear(i,j) ;
       }
       j=j+1 ;
      }
     j=0;
     }
   }
}
```

```
ldlat(i,j)


int i,j ;
{
/* load latitude of contact */
float fy,flat ;
int ilat ;
fy=shipplot[i].ybow[j] * 1.0 ;
flat=baselat + (fy * latoff) ;
flat=flat * 10.0;
ilat=flat ;
/* set flag to north */
shipplot[i].lat[j]=ilat | 020000 ;
}



ldlong(i,j)


int i,j ;
{
/* load longitude of contact */
float fx,flong ;
int ilong ;
fx=shipplot[i].xbow[j] * 1.0 ;
flong=baselong + (fx * longoff) ;
flong =flong * 10.0;
```

```
ilong=flong;
/* set flag to west */
shipplot[i].longtd[j] = ilong | 020000 ;
}



largang(i,j)


int i,j ;
{
/* load contact range */
float r1,t1,r2,t2,frange ;
int irange ;
r1=shipplot[0].xbow[1] * 1.0 ;
t1=shipplot[0].ybow[1] * 1.0 ;
r2=shipplot[i].xbow[j] * 1.0 ;
t2=shipplot[i].ybow[j] * 1.0 ;
frange= sqrt(pow((r2-r1),2.0) + pow((t2-t1),2.0));
frange=frange * 312.5 ;
frange=frange / 10.0 ;
irange=frange ;
shipplot[i].range[j]=irange ;
}



cangle(xh,yh,xt,yt)
```

```
int xh,yh,xt,yt;
{
/* calculate angle given head and tail points */
int iangle ;
float fxh,fyh,fxt,fyt,fangle,a,b,ftan;
fxh=xh;
fyh=yh;
fyt=yt;
fxt=xt;
a= fabs(fyt-fyh);
b= fabs(fxt-fxh);
ftan = b / a;
fangle = atan(ftan);
fangle=fangle * 57.3;
iangle = fangle;
return iangle;
}


ldcour(i,j)


int i,j ;
{
/* loads contact course  */
int xh,yh,xt,yt,alpha;
xh = shipplot[i].xhowl[j];
```

```
yh = shipplot[i].ybow[j];
xt = back[i].xtail[j];
yt = back[i].ytail[j];
if ((xt != 1000) && (!((xh == xt) && (yh==yt))))
{
if (xh == xt)
    {
    if (yh<yt) alpha = 0;
    else alpha = 180;
    }
else if (yh==yt)
    {
    if (xh>xt) alpha = 90;
    else alpha = 270;
    }
else if (xh>xt)
    {
    if (yh<yt) alpha =  cangle(xh,yh,xt,yt);
    else alpha = 180 - cangle(xh,yh,xt,yt);
    }
else if (xh<xt)
    {
    if (yh<yt) alpha = 360 - cangle(xh,yh,xt,yt);
    else alpha = 180 + cangle(xh,yh,xt,yt);
    }
if (alpha==360) alpha=0;
shipplot[i].course[j] = alpha;
} /* if (xt != 1000) */
else shipplot[i].course[j] = 0;
back[i].xtail[j] = xh;
```

```
back[i].ytail[j] = yh;
} /* ld cour (i,j) */


ldbear(i,j)


int i,j ;
{
/* load contact bearing */
int xs,ys,xc,yc,alpha,ibear,tbear,owncou,tempb;
xc = shipplot[i].xbow[j];
yc = shipplot[i].ybow[j];
xs = shipplot[0].xbow[1];
ys = shipplot[0].ybow[1];
if (xc==xs)
   {
   if (yc<ys) alpha = 0;
   else alpha = 180;
   }
else if (yc==ys)
   {
   if (xc>xs) alpha = 90;
   else alpha = 270;
   }
else if (xc>xs)
   {
   if (yc<ys) alpha =  cangle(xc,yc,xs,ys);
   else alpha = 180 - cangle(xc,yc,xs,ys);
```

```
    }
else if (xc<xs)
    {
    if (yc<ys) alpha = 360 - cangle(xc,yc,xs,ys);
    else alpha = 180 + cangle(xc,yc,xs,ys);
    }
owncou = shipplot[0].course[1];
tbear = alpha - owncou;
if (tbear < (-180)) tbear = 360 + tbear;
else if (tbear > 180) tbear = -360 + tbear;
temph = tbear;
ibear = abs(tbear);
if (temph>=0)
    ibear = (ibear | 020000); /* set s */
shipplot[i].bearing[j] = ibear;
}



ldcpatd(i,j)

int i,j;
{
/* this procedure loads cpa time and cpa distance to structure */
int icpat,icpad,imin;
float x0,y0,x1,y1,x2,y2,m,lbear,nbear,drm,xcpa,ycpa ;
float cpad,cpat,rang1,rang2 ,ospeed,x,y,thour,fmin;
if ((back[i].beartail[j] == 1000) || (cpact == 4))
{
```

```
rang1=(back[i].rangtail[j] * 10.0) ;
rang2=(shipplot[i].range[j] * 10.0 ) ;
if ((back[i].beartail[j] & 020000 ) > 0)
  lbear= ((back[i].beartail[j] & 057777) *1.0 ) / 57.3 ;
else
  lbear=(360.0 - (back[i].beartail[j] * 1.0)) / 57.3 ;
if (( shipplot[i].bearing[j] & 020000 ) > 0)
  nbear=((shipplot[i].bearing[j] & 057777) * 1.0) / 57.3 ;
else
  nbear=(360.0 - (shipplot[i].bearing[j] * 1.0)) / 57.3 ;
ospeed=shipplot[i].speed[j] * 1.0 * 2000.0;
if (back[i].beartail[j] != 1000)
{
x1=rang1 * (cos(lbear));
y1=rang1 * (sin(lbear));
x2=rang2 * (cos(nbear));
y2=rang2 * (sin(nbear));
x0=x2-x1;
y0=y2-y1;
if (( fabs(y0) - fabs(x0)) >= 0)
{
y=x0;
x = -y0;
x1 = -y1;
x2 = -y2;
y1=x1;
}
else
{
x=x0;
```

```
y=y0;
}
m=y/x;
drm=atan(m);
xcpa=((x1*pow(m,2)) - (y1*m)) / (pow(m,2) + 1.0);
ycpa=(y1 - (x1 * m)) / (pow(m,2) + 1.0);
cpad=sqrt(pow(xcpa,2) + pow(ycpa,2));
cpat=sqrt(pow((xcpa-x1),2) + pow((ycpa-y1),2)) / ospeed ;
cpad=cpad / 10.0;
icpad=fabs(cpad);
if (icpad > 16000) icpad=0;
if (cpat < 0 ) cpat=0.0;
if (cpat > 24) cpat=0.0;
icpat=fabs(cpat);
thour=icpat * 1.0;
icpat=icpat * 100;
fmin=fabs(cpat) - thour;
fmin=((fmin * 10.0) * 6.0 );
imin=fmin;
icpat=icpat + imin;
shipplot[i].cpatime[j]=icpat;
shipplot[i].cpadist[j]=icpad;
}
else
{
shipplot[i].cpatime[j]=0;
shipplot[i].cpadist[j]=0;
}
back[i].rangtail[j]=shipplot[i].range[j];
back[i].beartail[j]=shipplot[i].bearing[j];
```

```
                cpact =0;
                }
                else
                {
                cpact = cpact + 1;
                }

                } /* ldcpatd */
```

```
PL/M-80 COMPILER    MODULE MDSPDP.SRC                          MAY 1
979   PAGE   1


ISIS-II PL/M-80 V3.1 COMPILATION OF MODULE HANDLER
NO OBJECT MODULE REQUESTED
COMPILER INVOKED BY:  PLM80 :F1:MDSPDP.SRC NOOBJECT PAGEWIDTH(82) PA
GELENGTH(24) D
                    -ATE(MAY 1979) TITLE('MODULE MDSPDP.SRC')



              /* HANDLER: */
   1            HANDLER:DO;


                 /*************************************************
*
                  *      MDS HANDLER FOR THE PDP/11-MDS DATA
*
                  *      LINK.-
*
                  *
*
                  *
*
                  *      HANDLER WRITTEN IN PLM/80 UTILIZING
*
                  *      MDS/ISIS OPERATING SYSTEMS CALLS.
*
                  *
*
                  *************************************************
*/
```

```
                    /*  DECLARATIONS: ************/

  2   1             DECLARE LIT LITERALLY 'LITERALLY';
  3   1             DECLARE DCL LIT 'DECLARE';

                    /*  ISIS-II SYSTEM CONSTANTS **/

  4   1             DCL  TOP  LIT '0F800H'; /* TOP OF FREE SPACE */
  5   1             DCL  BASE LIT '0D400H';/* BASE OF PDP BUFFER */

                    /* PROGRAM CONSTANTS: ******/

  6   1             DCL     TRUE     LIT     '0FFH';
```

```
  7   1          DCL     FALSE     LIT     '000H';
  8   1          DCL     FOREVER   LIT     'WHILE 1';
  9   1          DCL     RCVD      LIT     '2EH';
 10   1          DCL     NEUTRAL   LIT     '0';
 11   1          DCL     RECEIVE   LIT     '1';
 12   1          DCL     TRANSMIT  LIT     '2';
 13   1          DCL     ACK       LIT     '06H';
 14   1          DCL     READ$ACCESS  LIT  '1';
 15   1          DCL     END$OF$BLOCK LIT '01H';
```

518

```
                /* GLOBAL VARIABLES: ********/

 16   1          DCL CRT$BUFFER (200) BYTE;
 17   1          DCL FILE$NAME (128 ) BYTE ;
 18   1          DCL PDP$BUF$ADDRESS ADDRESS INITIAL (BASE);
 19   1              DCL (PDP$BUFFER BASED PDP$BUF$ADDRESS) (9000)
BYTE;
```

```
20   1          DCL ( PDP$BUF$FIRST,
                      PDP$BUF$LAST,
                      PDP$BUF$NUMBER,
                      CRT$BUF$FIRST,
                      CRT$BUF$LAST,
                      CRT$BUF$NUMBER,
                      LENGTH$PDP$BUF,
                      LAST$LOC$PDP$BUF,
                      WRITE$STATUS,
                      DELETE$STATUS,
                      READ$STATUS,
                      OPEN$STATUS,
                      PDP$BUF$PTR,
                      CLOSE$STATUS,
                      CONSOL$STATUS,
                      BYTE$COUNT,
                      COUNT$TEMP,
                      AFT$IN ) ADDRESS ;
21   1          DCL ( MISSINGDATA,
                      STOP$FLAG,
                      SENT$ACK,
```

```
                        ALARM,
                        D1,D2,D3,
                        CHAR$TWO,
                        CHAR,
                        STATE,
                        PREVCHAR,
                        EOFILE,
                        SKIP$FIVE,
                        ECHOCHAR,
                        SAVECHAR ) BYTE ;
 22   1          DCL    CRTECHO BYTE INITIAL (0);
 23   1          DCL    PDPECHO BYTE INITIAL (0);

520

                    /*  SPECIAL CHARACTERS: ********/

 24   1          DCL  RUBOUT     LIT '7FH',
                      PROMPT     LIT '25H',  /*  PERCENT */
```

```
                    CONTROL$W LIT '17H',
                    CONTROL$N LIT '4EH',
                    CONTROL$R LIT '12H',
                    CONTROL$T LIT '14H',
                    CONTROL$Z LIT '1AH',
                    CONTROL$C LIT '03H',
                    CR        LIT '0DH',
                    LF        LIT '0AH',
                    BELL      LIT '07H';


521
                /*ISIS-II SYSTEM CALLS: ***********/

  25   1          OPEN:
                      PROCEDURE (AFT,FILE,ACCESS,MODE,STATUS ) EXTER
NAL;
  26   2                        DECLARE (AFT,FILE,ACCESS,MODE,STATUS )AD
DRESS;
  27   2          END OPEN;
```

```
  28   1          CLOSE:
                    PROCEDURE(AFT,STATUS) EXTERNAL;
  29   2                 DCL (AFT,STATUS) ADDRESS;
  30   2          END CLOSE;


  31   1          READ:
                   PROCEDURE(AFT,BUFFER,COUNT,ACTUAL,STATUS) EXTE
RNAL;
  32   2                DCL(AFT,BUFFER,COUNT,ACTUAL,STATUS) ADDRESS;
  33   2          END READ;


  34   1          WRITE:
                    PROCEDURE(AFT,BUFFER,COUNT,STATUS) EXTERNAL;
  35   2                DCL(AFT,BUFFER,COUNT,STATUS) ADDRESS;
  36   2          END WRITE;
```

```
 37   1          EXIT:
                     PROCEDURE EXTERNAL;
 38   2             DCL STATUS ADDRESS;
 39   2          END EXIT;



 40   1          CONSOL:
                       PROCEDURE(INFILE,OUTFILE,STATUS) EXTERNAL;
 41   2                   DCL (INFILE,OUTFILE,STATUS) ADDRESS;
 42   2          END CONSOL;


 43   1          DELETE:
                       PROCEDURE(FILE,STATUS) EXTERNAL;
 44   2                DCL(FILE,STATUS) ADDRESS;
 45   2          END DELETE;
```

```
 46   1          ERROR:
                      PROCEDURE (ERRNUM) EXTERNAL;
 47   2                  DCL (ERRNUM) ADDRESS;
 48   2          END ERROR;


 49   1          RENAME:
                       PROCEDURE(OLDFILE,NEWFILE,STATUS) EXTERNAL;
 50   2                   DCL(OLDFILE,NEWFILE,STATUS) ADDRESS;
 51   2          END RENAME;


524


                /*  PROCEDURES:**************/
```

```
 52   1          SET$TTY$2400: PROCEDURE;

                   /* SET TTY BAUD RATE TO 2400 */
 53   2             OUTPUT(245)=40H;
 54   2             OUTPUT(245)=4FH;
 55   2             OUTPUT(245)=37H;
 56   2          END;


 57   1       OUTPUT$STATUS$CRT: PROCEDURE BYTE;

                /* TRUE IF DATA OUTPUT LINE TO CRT READY */
 58   2          RETURN ROR (INPUT(247),2);
 59   2       END;
```

```
60   1          OUTPUT$STATUS$PDP: PROCEDURE BYTE;

                /* TRUE IF DATA OUTPUT LINE TO PDP READY */
61   2             RETURN ROR(INPUT(245),2);
62   2          END;



63   1          INPUT$STATUS$CRT: PROCEDURE BYTE;

                     /* TRUE IF DATA INPUT LINE FROM CRT READY */
64   2             RETURN ROR(INPUT(247),1);
65   2          END;


66   1          INPUT$STATUS$PDP: PROCEDURE BYTE ;

                /* TRUE IF DATA INPUT LINE FROM PDP READY */
67   2             RETURN ROR(INPUT(245),1) ;
68   2          END;
```

```
 69   1          SEND$CHAR$CRT: PROCEDURE (CHAR) ;

                 /* PRINT A CHARACTER TO THE CRT */
 70   2             DCL CHAR BYTE;
 71   2               DO WHILE NOT OUTPUT$STATUS$CRT;
 72   3               END;
 73   2               OUTPUT(246)= CHAR;
 74   2          END;


 75   1          SEND$CHAR$PDP: PROCEDURE (CHAR);

                 /* SEND A CHARACTER TO THE PDP */
 76   2             DCL CHAR BYTE;
 77   2               DO WHILE NOT OUTPUT$STATUS$PDP;
 78   3               END;
 79   2               OUTPUT(244)= CHAR;
```

```
 80   2          END;


                    /* CRLF: */
 81   1          CRLF: PROCEDURE ;

                 /* SEND CARRIAGE RETURN AND LINE FEED TO THE CRT *
/
 82   2             CALL SEND$CHAR$CRT(CR);
 83   2             CALL SEND$CHAR$CRT(LF);
 84   2          END;


 85   1          SEND$STRING$CRT: PROCEDURE (STRING$ADDRESS);

                 /* SEND MESSAGE AT STRING$ADDRESS UNTIL '$' IS
                    DETECTED */
 86   2             DCL STRING$ADDRESS ADDRESS;
 87   2             DCL TEMPCHAR BASED STRING$ADDRESS BYTE;
 88   2             DO WHILE TEMPCHAR <> '$';
```

```
 89   3            CALL SEND$CHAR$CRT(TEMPCHAR);
 90   3            STRING$ADDRESS=STRING$ADDRESS + 1;
 91   3            END;
 92   2         END;



 93   1         PRINT$TO$CRT: PROCEDURE (STRING$ADDRESS) ;

                /* PRINT A STRING TO THE CRT */
 94   2            DCL STRING$ADDRESS ADDRESS;
 95   2             CALL CRLF;
 96   2             CALL SEND$STRING$CRT(STRING$ADDRESS);
 97   2             CALL CRLF;
 98   2         END;



 99   1         READ$CRT$CHAR: PROCEDURE BYTE;
                /* READ A CHARACTER FROM THE CRT */
100   2            DCL CHAR BYTE;
```

```
101   2            CHAR= INPUT(246) AND 07FH;
102   2            IF CRTECHO OR (STATE=RECEIVE) THEN
103   2            CALL SEND$CHAR$CRT(CHAR);
104   2            RETURN CHAR;
105   2         END;


106   1         READ$CHAR$PDP:PROCEDURE BYTE;

                /* READ A CHARACTER FROM THE PDP */
107   2            DCL CHAR BYTE;
108   2            CHAR= INPUT (244) AND 07FH;
109   2            IF PDPECHO THEN CALL SEND$CHAR$PDP(CHAR);
                   /* CONVERT LOWER TO UPPER CASE */
111   2            IF (CHAR >=61H) AND (CHAR<=7AH) THEN
112   2            RETURN CHAR AND 0DFH;
113   2            RETURN CHAR;
114   2         END;
```

```
 115   1          GET$CHAR$CRT$BUF: PROCEDURE BYTE;

                  /* GET A CHARACTER FROM THE CRT BUFFER */
 116   2             DCL CHAR BYTE;
                     /* GET FIRST CHARACTER  */
 117   2             CHAR =CRT$BUFFER(CRT$BUF$FIRST);
 118   2             IF (CRT$BUF$FIRST:=CRT$BUF$FIRST+1)>LAST(CRT$BU
FFER)
                     THEN CRT$BUF$FIRST=0;/* WRAP AROUND */
 120   2             CRT$BUF$NUMBER=CRT$BUF$NUMBER - 1;
 121   2             RETURN CHAR;
 122   2          END;


 123   1          GET$CHAR$PDP$BUF: PROCEDURE BYTE;

                  /* GET A CHAR FROM THE PDP BUFFER */
 124   2             DCL CHAR BYTE;
                     /* GET FIRST CHARACTER */
 125   2             CHAR=PDP$BUFFER(PDP$BUF$FIRST);
```

```
 126   2            IF (PDP$BUF$FIRST:=PDP$BUF$FIRST + 1)>LAST$LOC$
PDP$BUF
                   THEN PDP$BUF$FIRST=0;
 128   2            PDP$BUF$NUMBER=PDP$BUF$NUMBER - 1;
 129   2            RETURN CHAR;
 130   2         END;



 131   1         PUT$CHAR$CRT$BUF: PROCEDURE (CHAR);

                   /* A CHAR IS PUT IN THE CRT BUFFER */
 132   2            DCL CHAR BYTE;
 133   2            IF(CRT$BUF$LAST:=CRT$BUF$LAST + 1)> LAST(CRT$BU
FFER)
                   THEN CRT$BUF$LAST=0;
 135   2            IF CRT$BUF$NUMBER= 0 THEN
 136   2               CRT$BUF$LAST=CRT$BUF$FIRST;
 137   2            CRT$BUFFER(CRT$BUF$LAST)=CHAR;
 138   2            CRT$BUF$NUMBER=CRT$BUF$NUMBER+1;
 139   2            ALARM=0; /* SET FOR NO ALARM FOR NEXT PASS */
 140   2         END;
```

```
 141   1          PUT$CHAR$PDP$BUF: PROCEDURE(CHAR);

                  /* PUT CHARACTER IN PDP BUFFER */
 142   2          DCL CHAR BYTE;
 143   2            IF(PDP$BUF$LAST:=PDP$BUF$LAST + 1)>LAST$LOC$PDP$
BUF
                     THEN PDP$BUF$LAST=0;
 145   2                IF(PDP$BUF$NUMBER=0)THEN
 146   2                  PDP$BUF$LAST=PDP$BUF$FIRST;
 147   2            PDP$BUFFER(PDP$BUF$LAST)=CHAR;
 148   2            PDP$BUF$NUMBER=PDP$BUF$NUMBER+1;
 149   2          END;


 150   1          CRT$BUF$FULL: PROCEDURE BYTE;

                  /* CHECK IF CRT BUFFER OVERFLOW */
 151   2                RETURN CRT$BUF$NUMBER=LENGTH(CRT$BUFFER);
 152   2          END;
```

```
153   1          PDP$BUF$FULL: PROCEDURE BYTE;

                 /* CHECK FOR PDP BUFFER OVERFLOW */
154   2              RETURN PDP$BUF$NUMBER=LENGTH$PDP$BUF;
155   2          END;


156   1          PRINT$HEX$NUMBER: PROCEDURE (CHAR);

                 /* PRINT HEXADECIMAL COUNTER */
157   2             DCL CHAR BYTE;
158   2             IF CHAR>9 THEN CALL SEND$CHAR$CRT(CHAR-10+'A');
160   2                ELSE CALL SEND$CHAR$CRT(CHAR+'0');
161   2          END;
```

```
 162   1          FORMAT$HEX :PROCEDURE (CHAR);
                  /* FORMAT DECIMAL NUMBER FOR HEXADECIMAL OUTPUT */
 163   2             DCL CHAR BYTE;
 164   2              CALL PRINT$HEX$NUMBER(SHR(CHAR,4));
 165   2              CALL PRINT$HEX$NUMBER(CHAR AND 0FH);
 166   2          END;



 167   1          PRINT$CHAR$COUNT: PROCEDURE ;

                  /* PRINT DECIMAL COUNTER IN HEXADECIMAL FORMAT */
 168   2             CALL CRLF;
 169   2             CALL SEND$STRING$CRT(.('CHARACTER COUNT:$'));
 170   2             IF D1 <> 0 THEN CALL FORMAT$HEX(D1);
 172   2             IF D2 <> 0 THEN CALL FORMAT$HEX(D2);
 174   2             CALL FORMAT$HEX(D3);
 175   2          END;
```

```
 176   1          INIT$CHAR$COUNT: PROCEDURE;

                  /* CLEAR DECIMAL COUNTER */
 177   2             D3,D2,D1=0;
 178   2          END;



 179   1          COUNT$CHAR: PROCEDURE ;

                  /* INCREMENT DECIMAL COUNTER */
 180   2             D3=DEC(D3+1);
 181   2             D2=DEC(D2 PLUS 0);
 182   2             D1=DEC(D1 PLUS 0);
 183   2          END;



 184   1          INIT$NEUTRAL$STATE: PROCEDURE;

                  /* INITIALIZE NEUTRAL STATE */
```

```
 185   2            STATE=NEUTRAL;
 186   2            CALL PRINT$TO$CRT(.('SYSTEM IN NEUTRAL STATE: $
'));
 187   2            CALL CRLF;
 188   2            CALL SEND$CHAR$PDP(CR);
 189   2            END;



 190   1          INIT$RECEIVE$STATE: PROCEDURE ;

                  /* INITIALIZE RECEIVING STATE */
 191   2            PDP$BUF$FIRST=0;
 192   2            PDP$BUF$LAST=0;
 193   2            PDP$BUF$NUMBER=0;
 194   2            PREVCHAR=' ';
 195   2            STATE=RECEIVE;
 196   2            CALL PRINT$TO$CRT(.('SYSTEM IN RECEIVE STATE: $'
));
 197   2            CALL CRLF;
 198   2            CALL INIT$CHAR$COUNT;
 199   2            SKIP$FIVE = 0;
 200   2            CALL SEND$CHAR$PDP(CR);
```

```
 201   2          END;



 202   1          INIT$TRANSMIT$STATE: PROCEDURE;

                  /* INITIALIZE TRANSMIT STATE */
 203   2             EOFILE=0;
 204   2             ECHOCHAR=1;
 205   2             SENT$ACK = FALSE;
 206   2             SAVECHAR=' ';
 207   2             STATE=TRANSMIT;
 208   2             CALL PRINT$TO$CRT(.('SYSTEM IN TRANSMIT STATE:
$'));
 209   2             CALL CRLF;
 210   2             STOP$FLAG=FALSE;
 211   2             CALL INIT$CHAR$COUNT;
 212   2          END;



 213   1          BREAK$STATE: PROCEDURE ;
```

```
                    /* INTERRUPT THE PDP */
 214   2                DCL I BYTE;
 215   2                 DO I = 1 TO 3;
 216   3                    CALL SEND$CHAR$PDP(RUBOUT);
 217   3                 END;
 218   2              END;



 219   1              END$R : PROCEDURE ;

                    /* TERMINATE RECEIVE STATE ,AND RETURN TO NEUTRAL
STATE */
 220   2                 CALL PRINT$TO$CRT(.('RECEIVE STATE TERMINATED B
Y OPERATOR.$')
             -    );
 221   2                 CALL PRINT$TO$CRT(.('NO FILE CREATED AT FLOPPY
DISK.$'));
                    /* DISCARD PDP BUFFER CONTENTS */
 222   2                 PDP$BUF$FIRST=0;
 223   2                 PDP$BUF$LAST=0;
 224   2                 PDP$BUF$NUMBER=0;
```

```
                    /* SEND BREAK SIGNAL TO THE PDP */
 225   2                  CALL BREAK$STATE;
 226   2                  CALL CLOSE(AFT$IN,.CLOSE$STATUS);
 227   2                  CALL DELETE(.FILENAME,DELETE$STATUS);
 228   2              END;



 229   1              END$T: PROCEDURE ;

                    /* TERMINATE TRANSMIT STATE ,RETURN TO NEUTRAL STA
TE */
 230   2                 CALL PRINT$TO$CRT(.('TRANSMIT STATE TERMINATED
BY OPERATOR.$'
                -   ));
 231   2                  CALL PRINT$TO$CRT(.('PARTIAL FILE CREATED AT PD
P.$'));
                    /* SEND BREAK SIGNAL TO PDP */
 232   2                  CALL SEND$CHAR$PDP(ACK);
 233   2                  SENT$ACK = TRUE ;
 234   2                  CALL CLOSE (AFT$IN,.CLOSE$STATUS);
 235   2                  CALL CONSOL (.(':CI:$'),.(':VO:$'),.CONSOL$
STATUS);
 236   2              END;
```

```
 237   1          WRITE$RECORD$TO$DISK:PROCEDURE;

                  /* WRITE ONE RECORD FROM PDPBUF TO DISK */
 238   2             CALL WRITE(AFT$IN,.PDP$BUFFER(PDP$BUF$PTR),128,
.WRITE$STATUS)
                 -   ;
 239   2             CALL WRITE(0,.PDP$BUFFER(PDP$BUF$PTR),128,.WRIT
E$STATUS);
 240   2             PDP$BUF$PTR = PDP$BUF$PTR + 80H;
 241   2             IF PDP$BUF$PTR > LAST$LOC$PDP$BUF THEN
 242   2               DO;
 243   3               PDP$BUF$NUMBER = 0;
 244   3               END;
 245   2             ELSE PDP$BUF$NUMBER = PDP$BUF$NUMBER - 128;
 246   2          END;
```

```
 247   1          WRITE$PDP$BUFFER: PROCEDURE;

                  /* WRITE ENTIRE PDP BUFFER TO DISK */
 248   2                PDP$BUF$PTR = 0002H;
 249   2                PDP$BUF$NUMBER = PDP$BUF$NUMBER -3;
                     /* PAD PDP BUFFER UNTIL PDP$BUF$NUMBER IS A MUL-
                        TIPLE OF 128 */
 250   2                DO WHILE ((PDP$BUF$NUMBER - 2) AND 0177Q) <>
0;
 251   3                   CALL PUT$CHAR$PDP$BUF(' ');
 252   3                END;
 253   2                   CALL OPEN(.AFT$IN,.FILE$NAME,2,0,.OPEN$STAT
US);
 254   2              DO WHILE PDP$BUF$NUMBER <> 2;
                        /* WRITE NEXT 128 BYTE RECORD TO DISK */
 255   3                CALL WRITE$RECORD$TO$DISK;
 256   3              END;
 257   2                   CALL CLOSE (AFT$IN,.CLOSE$STATUS);
 258   2              PDP$BUF$PTR = 0002H;
 259   2              PDP$BUF$LAST,PDP$BUF$FIRST = 0;
 260   2          END;
```

```
                        /* REBOOT: */
 261   1              REBOOT: PROCEDURE;

                       /* GO BACK TO MDS OPERATING SYSTEM : ISIS-11 */
 262   2                 IF MISSINGDATA THEN CALL PRINT$TO$CRT(
                  .('NEUTRAL STATE: SYSTEM MAY NOT HAVE RECEIVED ALL PDP
 CHAR TRANSMIT
                -    TED $'));
 264   2                 CALL PRINT$TO$CRT(
                          .('NEUTRAL STATE AND REBOOTING TO ISIS-11 $'))
;
 265   2                 CALL CONSOL(.(':CI:$'),.(':VO:$'),.CONSOL$STATU
S);
 266   2                 CALL EXIT;
 267   2              END;



                    /* MAIN ROUTINE: ****************/
```

```
 268   1        MAIN: DO;
 269   2              CALL SET$TTY$2400;
 270   2              CALL READ (1,.FILENAME,128,.BYTE$COUNT,.READ$S
TATUS);
 271   2              CALL WRITE(0,.FILE$NAME,14,.WRITE$STATUS);

                    /* BEGIN TESTING PORTS , AND SELECT THE APPROPIATE
 ACTION */
                    /* SET THE PDP BUFFER PARAMETERS */
 272   2               LENGTH$PDP$BUF=TOP-BASE;
 273   2               LAST$LOC$PDP$BUF=LENGTH$PDP$BUF-1;
                    /* NOW,THE POINTERS OF THE BUFFERS OF THE CRT AND
THE
                       PDP ARE INITIALIZED */
 274   2               PDP$BUF$FIRST,
                       PDP$BUF$LAST,
                       PDP$BUF$NUMBER,
                       CRT$BUF$FIRST,
                       CRT$BUF$LAST,
                       CRT$BUF$NUMBER=0;
```

```
                    /* INITIALIZE SYSTEM BY ENTERING THE NEUTRAL STATE
 :
                       PDP TO CRT AND CRT TO PDP; UNIX(O/S) TYPE COMMU
-
                           NICATION. */

 275   2                   MISSINGDATA=FALSE;
 276   2                   ALARM=FALSE;
 277   2                   CALL INIT$NEUTRAL$STATE;


                    /* BEGIN INFINITE LOOP: ***************/


 278   2                 DO FOREVER;

                    /* FIRST CASE  INPUT FROM CRT */


 279   3                 IF INPUT$STATUS$CRT THEN
 280   3                  DO;  /* CRT INPUT */
```

```
                        /* CRT BUFFER FULL */
 281    4               IF CRT$BUF$FULL THEN
 282    4                DO; /* SOUND ALARM ; 5 BEEPS */
 283    5                 IF NOT ALARM THEN
 284    5                  IF (ALARM:=OUTPUT$STATUS$CRT) THEN
 285    5                   DO;
 286    6                     CALL SEND$CHAR$CRT(BELL);
 287    6                     CALL SEND$CHAR$CRT(BELL);
 288    6                     CALL SEND$CHAR$CRT(BELL);
 289    6                     CALL SEND$CHAR$CRT(BELL);
 290    6                     CALL SEND$CHAR$CRT(BELL);
 291    6                   END;
 292    5                END; /* SOUND ALARM */
                        ELSE /* CRT BUFFER NOT FULL */
 293    4                DO;
 294    5                 CHAR=READ$CRT$CHAR;
 295    5                  DO CASE STATE;
                            /* NEUTRAL STATE */
 296    6                   DO;
                              /* CHECK FOR A COMMAND */
 297    7                  IF CHAR =CONTROL$T THEN
```

```
298   7                 CALL INIT$TRANSMIT$STATE;ELSE
299   7               IF CHAR=CONTROL$R THEN
300   7                 CALL INIT$RECEIVE$STATE; ELSE
301   7               IF CHAR=CONTROL$C THEN
302   7                 CALL REBOOT; ELSE
                      /* NOT A COMMAND */
303   7               CALL PUT$CHAR$CRT$BUF(CHAR);
304   7                END; /* END NEUTRAL */



                       /* RECEIVING STATE */
305   6                 DO;
306   7                  IF CHAR=CONTROL$C THEN
307   7                      DO;
308   8                      CALL END$R;
309   8                      CALL REBOOT;
310   8                      END;
                         ELSE /* NOT A COMMAND */
311   7                    CALL PUT$CHAR$CRT$BUF(CHAR);
312   7                  END; /* END RECEIVE */
```

```
                        /* TRANSMIT STATE */
313   6                  DO;
                        /* NOT A COMMAND */
314   7                    CALL PUT$CHAR$CRT$BUF(CHAR);
315   7                  END; /* END TRANSMIT */
316   6                END; /* END CASE STATEMENT */
317   5              END; /* END ELSE CRT BUFFFER NOT FULL */
318   4            END; /* INPUT FROM CRT */


                   /* SECOND CASE: INPUT FROM PDP */
319   3            IF INPUT$STATUS$PDP THEN
320   3             DO; /* PUT DATA IN PDP BUFFER UNLESS FULL */
321   4              IF STATE=RECEIVE THEN
322   4                DO; /* RECEIVING DATA  */
                         /* PDP BUFFER FULL: GENERATE ERROR MESSAGE ,
```

```
                        RETURN TO NEUTRAL STATE */
 323   5                IF PDP$BUF$FULL THEN
 324   5                 DO;
 325   6                        CALL BREAK$STATE;
 326   6                        CALL PRINT$TO$CRT(
                                .('RECEIVING STATE : PDP BUFFER OVERFL
CW.$'));
 327   6                        CALL PRINT$TO$CRT(.('NO FILE CREATED A
T FLOPPY DISK.
                  -   $'));
 328   6                        CALL REBOOT;
 329   6                 END; /* PDP BUFFER FULL */
                         /* BUFFER NOT FULL */
                         /* GET CHARACTER FROM PDP */
 330   5                 CHAR=READ$CHAR$PDP;
                         /* PDP PROMPTING : TERMINATE RECEPTION */
 331   5                 IF ((PREVCHAR=LF) OR (PREVCHAR=CR)) AND CHAR=
PROMPT
                          THEN
 332   5                  DO; /* PROMPTING */
                        /* WRITE PDP BUFFER TO DISK */
 333   6                     CALL WRITE$PDP$BUFFER;
 334   6                     CALL PRINT$TO$CRT(.('PDP PROMPTING:END OF
 RECEPTION.$')
                  -   );
```

549

```
 335   6                    CALL PRINT$TO$CRT(
                               .('PDP BUFFER/FILE WRITTEN TO DISK.$')
);
                          /* PRINT NUMBER OF CHARACTERS TRANSMITTED
                             FROM PDP BUFFER TO DISK */
 336   6                      CALL PRINT$CHAR$COUNT;
 337   6                      CALL SEND$STRING$CRT(
                              .(' BYTES TRANSMITTED FROM PDP TO FLOPPY
DISK.$'));
 338   6                            CALL CRLF;
                          /* RECEPTION COMPLETE:RETURN TO NEUTRAL STATE
*/
 339   6                      CALL INIT$NEUTRAL$STATE;
 340   6                    END; /* PROMPTING */
                            ELSE
 341   5                    IF CHAR=END$OF$BLOCK THEN
 342   5                  DO;
 343   6                      CALL WRITE$PDP$BUFFER;
 344   6                      CALL PRINT$TO$CRT(
                              .('RECEIVE STATE: RECEIVED BLOCK.$'));
                           /* CRT ACKNOWLEDGE RECEPTION FROM PDP */
 345   6                      CALL PUT$CHAR$CRT$BUF(RCVD);
 346   6                      CALL PUT$CHAR$CRT$BUF(CR);
 347   6                  END;
```

```
                    ELSE /* NOT END OF RECEPTION-DATA */
 348   5              DO;
 349   6               PREVCHAR=CHAR;
 350   6               CALL PUT$CHAR$PDP$BUF(CHAR);
                       /* INCREMENT NUMBER OF CHARS RECEIVED */
 351   6                       IF (SKIP$FIVE < 4) THEN
 352   6                       DO;
 353   7                         SKIP$FIVE = SKIP$FIVE + 1;
 354   7                       END;
                               ELSE
 355   6                       DO;
 356   7                  CALL COUNT$CHAR;
 357   7                       END;
 358   6              END;
 359   5             END; /* END RECEIVING */
                    ELSE /* NEUTRAL OR TRANSMIT STATE */
 360   4             DO;
                      /* PDP BUFFER FULL */
 361   5               IF PDP$BUF$FULL THEN MISSINGDATA=1;
                      /* BUFFER NOT FULL */
                      ELSE
```

```
 363   5              DO;
 364   6                  CHAR=READ$CHAR$PDP;
 365   6                  IF SAVECHAR=CHAR THEN ECHOCHAR=1;
 367   6                  CALL PUT$CHAR$PDP$BUF(CHAR);
 368   6              END;
 369   5            END; /* NEUTRAL OR TRNSMIT STATE */
 370   4          END; /*PUT DATA IN PDP BUFFER UNLESS FULL */



                 /* THIRD CASE: SEND DATA FROM PDP TO CRT ,OR DISK
*/
 371   3          IF OUTPUT$STATUS$CRT THEN
                 /* CAN SEND DATA TO CRT */
 372   3           DO;
 373   4            IF STATE<> RECEIVE THEN
 374   4             DO; /* CHECK IF SOMETHING FOR THE CRT */
 375   5              IF PDP$BUF$NUMBER > 0 THEN
 376   5              CALL SEND$CHAR$CRT(GET$CHAR$PDP$BUF);
 377   5             END;
                   /* ELSE (RECEIVING) DATA FROM PDP TO DISK NOT TO
 CRT */
```

```
 378   4            END; /* CAN SEND DATA TO THE CRT */




                  /*FOURTH CASE: SEND DATA TO PDP */
 379   3           IF OUTPUT$STATUS$PDP THEN
 380   3            DO; /* SEND DATA TO PDP */
 381   4             IF STATE <> TRANSMIT THEN
 382   4              DO; /* CHECK IF CRT HAS SOMETHING FOR THE PDP *
/
 383   5               IF CRT$BUF$NUMBER > 0 THEN
 384   5               CALL SEND$CHAR$PDP(GET$CHAR$CRT$BUF);
 385   5              END; /* SEND DATA TO PDP */
                     ELSE /* TRANSMITTING DATA */
 386   4              DO;

 387   5                       CALL OPEN (.AFT$IN,.FILE$NAME,1,0,.OPE
N$STATUS);
 388   5               BYTE$COUNT=1;
 389   5                       CALL SEND$CHAR$PDP(CR);
 390   5              DO WHILE (BYTE$COUNT<>0 AND STOP$FLAG = FALSE)
;
```

```
 391   6                    IF INPUT$STATUS$CRT THEN
 392   6                      DO;
 393   7                      CHAR$TWO=READ$CRT$CHAR;
 394   7                      IF CHAR$TWO=CONTROL$C THEN
 395   7                        DO;
 396   8                        CALL END$T;
 397   8                        STOP$FLAG = TRUE;
 398   8                        END;
 399   7                      END;
 400   6                    IF INPUT$STATUS$PDP THEN
 401   6                     DO;
 402   7                     IF (CHAR:=READ$CHAR$PDP) = '+' THEN
 403   7                     DO;
 404   8                          CALL READ(AFT$IN,.PDP$BUFFER,128,
.BYTE$COUNT,
                                .READ$STATUS);
 405   8                        CALL CONSOL (.(':CI:$'),.(':TO:$')
,.CONSOL$STATU
                -   S);
 406   8                        CALL WRITE(0,.PDP$BUFFER,BYTE$COUN
T,.WRITE$STATU
                -   S);
 407   8                        CALL CONSOL(.(':CI:$'),.(':VO:$'),
.CONSOL$STATUS
                -   );
```

```
 408   8                        CALL WRITE(0,.PDP$BUFFER,BYTE$COUN
T,.WRITE$STATU
            -   S);
 409   8                        CHAR=' ';
 410   8                        IF ((BYTE$COUNT>0) AND (BYTE$COUNT
<128)) THEN
 411   8                          DO;
 412   9                            CALL SEND$CHAR$PDP(ACK);
 413   9                            SENT$ACK=TRUE;
 414   9                          END;
 415   8                        COUNT$TEMP=0;
 416   8                        DO WHILE (BYTE$COUNT-COUNT$TEMP)<>
0;
 417   9                        CALL COUNT$CHAR;
 418   9                        COUNT$TEMP=COUNT$TEMP+1;
 419   9                        END;
 420   8                    END;
 421   7                    END;
 422   6                END;
 423   5                IF(SENT$ACK = FALSE) THEN
 424   5                  DO;
 425   6                    CALL SEND$CHAR$PDP(ACK);
 426   6                  END;
 427   5                CALL CLOSE(AFT$IN,.CLOSE$STATUS);
```

```
 428   5              CALL PRINT$CHAR$COUNT;
 429   5              CALL SEND$STRING$CRT(
                      .(' BYTES TRANSMITTED FROM FLOPPY DISK TO PDP.
$'));
 430   5              CALL CRLF;
 431   5              CALL PRINT$TO$CRT(
                      .('LEAVING TRANSMIT STATE; ENTER NEUTRAL STATE
.$'));
 432   5              CALL INIT$NEUTRAL$STATE;
 433   5             END; /*TRANSMIT */
 434   4            END; /* END FOURTH CASE */
 435   3          END; /* DO FOREVER */
 436   2        END; /* END MAIN ROUTINE */
 437   1      END; /* H A N D L E R */
```


MODULE INFORMATION:

```
     CODE AREA SIZE     = 0A4CH   2636D
     VARIABLE AREA SIZE = 0190H    400D
     MAXIMUM STACK SIZE = 000AH     10D
     835 LINES READ
```

0 PROGRAM ERROR(S)

END OF PL/M-80 COMPILATION

pdpreceive.c

```
int count,fout;
int buf[259];
char c;
int i;
int v[3];
main(argc,argv)
char **argv;
{
    int out();
    signal(2,out);
    if((fcreat(argv[1],buf)==-1)
        { printf("cannot open file");
          exit();
        }
    gtty(0,v);
    v[1] =& 0177776;
    v[2] =+ 020;
    stty(0,v);
    printf("+");
    while (1)
    {
        for (i =0;i<128;i++)
        {
            if (( read(0,&c,1))<= 0 ) {printf("+");}
            if(c==0o)
                { fflush(buf);
                  printf("+");
                  out();
                exit();
                }
            if (c != 015)
```

```
                {
                putc(c,buf);
                }
            }
            fflush(buf);
            printf("+");
        }
    }
    out()
    {
        v[1] =| 1;
        v[2] =- 020;
        stty(0,v);
        close(buf[0]);
        gtty (0,v);
    }
```

```
char cr 015;
char lf 012;
char EOB 1;
char RCVD '.';
char c;
int total 0;
int ibuf [259];
int nr 0;
int nrmax 80;
int fd;


main(argc,argv) int argc; char **argv;
{
argv++;
 if((fd=open(*argv,0))<0)
   {eot();
    printf("cannot open %s0, *argv);
    exit();
   }


ibuf[0]=fd;
ibuf[1]=0;
ibuf[2]=0;


while(1)
{if (c==-1)    {eot(); c = 0; argv--; break;}
 if(c== ':')
```

```
        {if(nr>=nrmax)
            {putchar(FOB);
             while(getchar() != RCVD);
             nr=0;
            }
         else nr++;
        }
    putchar(c);
    total++;
    c = getc(ibuf);
}
close(fd);
  }


eot()

{putchar(cr);
 putchar(lf);
 putchar('%');
}
```

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